LEVEL II

DIVISION REAL TIME APPLICATIONS REPORT

(DIVRAS)

Final Report

Methodology, Algorithms, and Experimentation Results Supporting Target Data Routing and Commander's Display

Prepared For The
Battlefield Systems Integration Directorate
USA DARCOM

IBM

DIVISION REAL TIME APPLICATIONS REPORT

(DIVRAS)

FINAL REPORT

Submitted to:

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SECTION 1. EXECUTIVE SUMMARY

The purpose of the Division Real-Time applications specifications (DIVRAS) program is to improve the focus of division command and control toward the real-time execution of weapons and forces. This emphasis is consistent with recent tactical concepts and evolving doctrine requiring the division command post to be a highly mobile center capable of perceiving the battlefield situation and executing responsive actions in a matter of hours or minutes. At present the Tactical Operations System (TOS) which is to support the Division command and control functions does not have this emphasis. The existing TOS functions which have been defined and developed for the TOS Operable Segment (TOS^2), are oriented toward intelligence analysis and the support of operational planning.

The thrust for defining an integrated, highly responsive set of real-time command and control applications at Division, is the result of a number of factors:

- o There have been unparalled advances in surveillance systems which are capable of providing the division commander with real-time data on enemy movements and targets.

- o Recent changes in the threat and the battlefield environment may require a smaller Tactical Operations Center (TOC) dealing with the real-time battle, while longer term analysis and planning functions are performed elsewhere.

- o The fires and Maneuver functions in the DTOC require extensive definition of command and control requirements if they are to effectively utilize the available real-time data.

- o The concept of improving overall responsiveness by organizing the tactical battlefield systems into a series of somewhat self-contained "closed loops", requires a similar redefinition of

the Division Command and control functions to insure that combat information is routed through the DTOC only when there is "value added" by doing so.

Recent efforts by USATRADOC's Combined Arms Center and USA DARCOM's Battlefield Systems Integration Directorate have led to an emerging concept for a Division Tactical Operations Center approach which allows the DTOC to accomodate organizationally, procedurally, and systematically the large number of real-time collateral information sources which will be available to Division. The purpose of this program is to define specifically the functional applications which will allow the division commander and staff to effectively make use of this information.

In order to provide the level of definition needed in this effort, a two step approach has been used:

1. A functional analysis of the combat information flow at Division, and a definition of command and control requirements to support that flow.

2. Development, experimentation, and demonstration of the real-time functional applications needed to support the Division Fires and Maneuver elements; utilizing a workshop-oriented ADP testbed.

The specific objectives, approach, and results to date of these tasks are summarized in the remainder of this section.

1.1 OBJECTIVES

The objectives of the DIVRAS program are depicted graphically in

figure 1.1-1. The immediate goal of the program is to specify the application functions for the target data routing and a simplified commander's display in support of the Fires and Maneuver elements of the DTOC. The overall objective is to have these functional applications sufficiently defined so that they may be incorporated in the ROC, DCP, and other supporting requirements documentation for the Tactical Operations System ASARC/DSARC, scheduled for late 1977. The steps to this objective, as outlined logically in Figure 1.1-1, are the following:

- Development and documentation of the specific functional applications within the DIVRAS program.

- Review, modification, and final definition of the real-time application requirements by the Combined Arms Center Development Activity (CACDA).

- An analysis of the feasability of validating the real-time applications using TOS^2 or an alternative system in a timely manner.

- As a minimum, incorporating the approved requirements in the ASARC/DSARC supporting documentation for the TOS Engineering Development Model while pursuing final field experimental validation.

1.2 DIVRAS CONCEPT

The concept for utilizing combat information for effecting the real-time execution of target data routing and the maneuver of forces is depicted in Figure 1.2-1. The concept is based on two primary tenets:

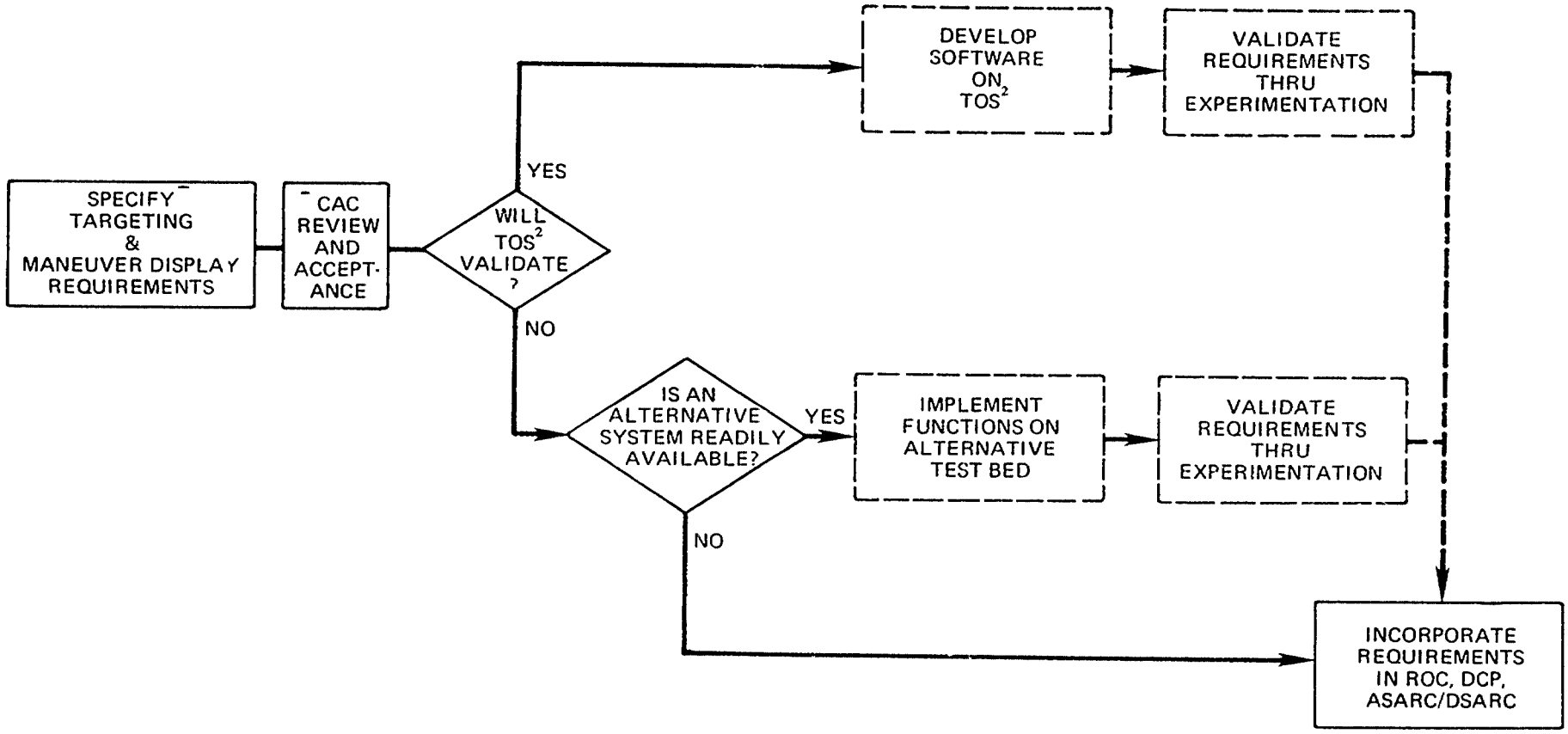


Figure 1.1-1. PROGRAM OBJECTIVES.

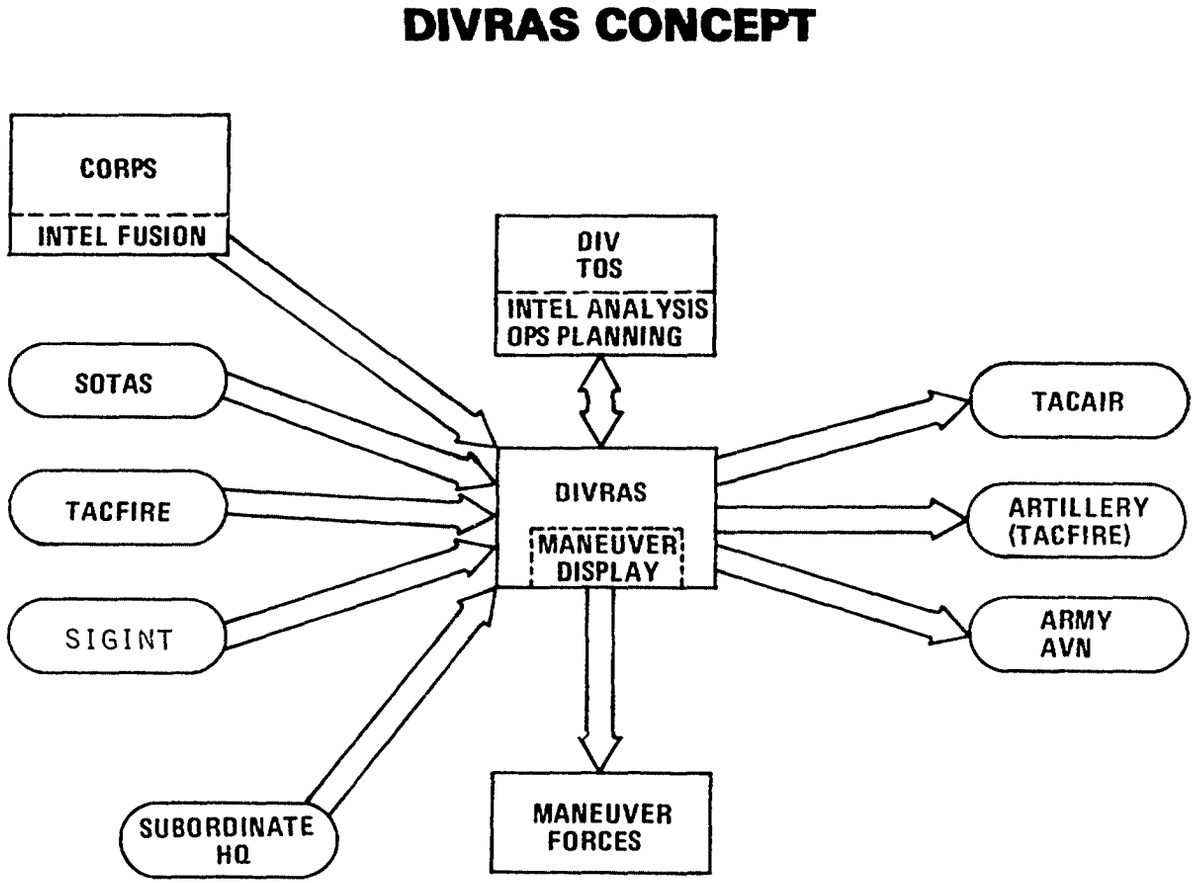


Figure 1.2-1. DIVRAS CONCEPT.

1. The Division CP can effectively combine target intelligence from multiple sources with the commander's real-time priorities and rules of engagement to rapidly identify and forward to weapon systems high-value targets.

2. The commander may effectively utilize the large volume of real-time data available from target acquisition sensors to obtain graphically a real-time picture of the battlefield situation.

As indicated in the figure, the concept is directed toward accomplishing these functions while remaining compatible with the existing TOS^2 functions for intelligence analysis and operations planning.

There are five principal sources for combat information which are addressed by the DIVRAS concept. These are:

- o The Corps TOC
- o The Stand-Off Target Acquisition System (SOTAS)
- o TACFIRE
- o The Division SIGINT sources
- o The Subordinate Headquarters

Of these five the key to the real-time DIVRAS concept are the SOTAS TACFIRE, and SIGINT sources which provide data on enemy "Movers", "Shooters," and "Emitters". The DIVRAS concept handles data in these three categories as an effective means of addressing both the target data routing and maneuver functions. In the targeting applications, target intelligence from "mover", "shooter" and "emitter" reports (together with photint and fused intelligence from Corps) is merged automatically at

the DTOC and routed to a weapon system with appropriate additional analysis and concurrence of the target analyst. The objective is to allow the analyst to rapidly identify, separate, and forward high-value target information from the large volume incoming stream of target intelligence reports.

For maneuver display the DIVRAS concept calls for presenting to the commander a simplified, threat-oriented, portrayal of the battlefield situation and allowing him to utilize all of the available real-time data on "mover" "shooter" and "emitter" locations to supplement the well-analysed, but not as timely intelligence product. The key in this case is a simple graphic presentation of the "movers"; "shooters" and "emitters" in order to identify "tell tale" clusters which indicate enemy concentrations or significant force movement. The emphasis here is not on extensive single report analysis of the target intelligence data stream, but rapid and simple presentation of this large volume of data to deduce enemy situation and intent.

1.3 APPROACH

The overall approach to the DIVRAS program is indicated in Figure 1.3-1. The program is structured in three major working areas which are integrated in the later part of the effort to produce the total functional requirements and an effective workshop and demonstration capability. The three major areas of investigations are:

1. Information Flow and Interoperability Analysis - To develop a battlefield scenario, analyze information flow, and determine message traffic and content for combat information reaching the DTOC.

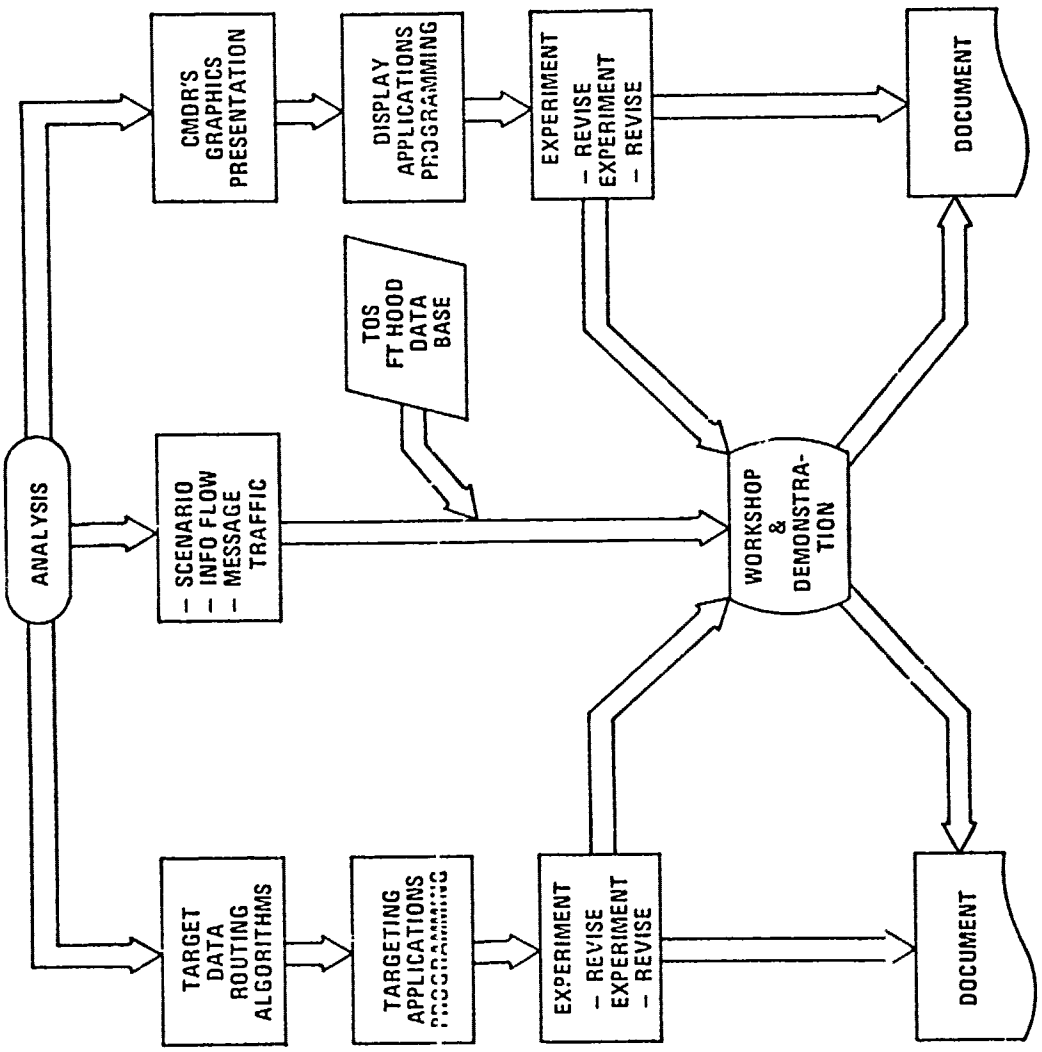


Figure 1.3-1. APPROACH.

2. Target Data Routing Analysis - Development of Target data routing algorithms to support the Fires targeting analyst and experimentation and demonstration of these algorithms.

3. Commander's Maneuver Display Analysis - Development of the manipulation, map background, and symbology requirements for a simplified commander's display, and experimentation and demonstration of the concept using a workshop test bed.

The first part of this effort was the development of the information flow and the related requirements for target data routing and the maneuver display, The requirements were scenario driven, using the SCORES European scenario developed by TRADOC as a representative battlefield situation and transferring the situation to the Ft. Hood area of Texas, so as to be consistent in unit organization, and geographic locale with the TOS, FM 222 Ft. Hood data base. This data base was provided by the USA ARTADS and provides the task organization and status of forces data which is used in the workshop test bed. Against this situation and scenario a simulation was performed to determine the target acquisition data and unit reporting which would be generated by the five DIVRAS sources. From this a timed message sequence was developed for use in experimentation and demonstrations.

The development and experimentation of the targeting algorithms in the workshop test bed has been supported by the use of the National Military Command System Information Processing System (NIPS). NIPS is a sophisticated highly-tested data base management system which has been used effectively in the DIVRAS program to accomplish the following:

1. Translation of the TOS^2 Ft. Hood Data Base into an existing file system to support further applications experimentation.

2. Provision for most of the equivalent TOS^2 functions for add, delete, change and query of the data above.

3. Development of additional capability for machine correlation aids for the target analyst.

4. Provide specific ADP tools to aid the target Analyst function in integrating the commander's rules of engagement.

The development and experimentation with the commander's maneuver display requirements in the workshop test bed is supported by the Digital Television Color Graphic Simulation Facility. This is a computer-driven color display and graphics manipulation capability that has been used extensively in the development of graphics presentation alternatives. It has been used in the DIVRAS program to provide a simplified maneuver display which will portray:

1. An overall maneuver presentation which allows determination of the immediate situation, areas of enemy concentration, and advancing enemy threats.

2. Subordinate or selectable displays of real-time, "mover", "shooter" and "emitter" activity.

3. Friendly forces capable of responding to potential threats or to support the need for offensive actions.

1.4 RESULTS

The results discussed in this draft report reflect only the functional analysis, requirements definition, and workshop development phases of this program. The conclusions and results are, therefore preliminary, to be refined in the final report after the experimentation and demonstration phases have been completed. The results of the program to date include:

- o Development of an information flow and an interoperability approach for the major DIVRAS interfaces.

- o Establishment of the workshop test bed for use in the experimentation and demonstration of DIVRAS.

- o Definition and test bed implementation of target data routing algorithms to support the Fires element.

- o Definition and test bed implementation of a maneuver display to support the commander in perceiving the real-time battlefield situation and recognizing enemy intent.

Figure 1.4-1 indicates what has been analysed and is being demonstrated in the areas of information flow and interoperability. Section 4 of this report defines the analysis and results for: the criteria for direct routing of information to weapon systems or appropriate command echelons; and the message types and formats required to support the DIVRAS concept in exchanging data between each of the five sources and the DTOC. Section 5 defines further the necessary functions of Translation and Inference needed to effectively perform the targeting functions while interfacing the five sources and the TOS data base.

A simulation output of over 6000 source reports has been used to examine these interfaces and experiment with the targeting and graphics functions. The derivation and use of this data is provided in Section 3 of this report.

Figure 1.4-2 illustrates the workshop experimentation center established for the DIVRAS program. The center consists of two analyst positions; one for maneuver and one for fires. Each position is supported by both

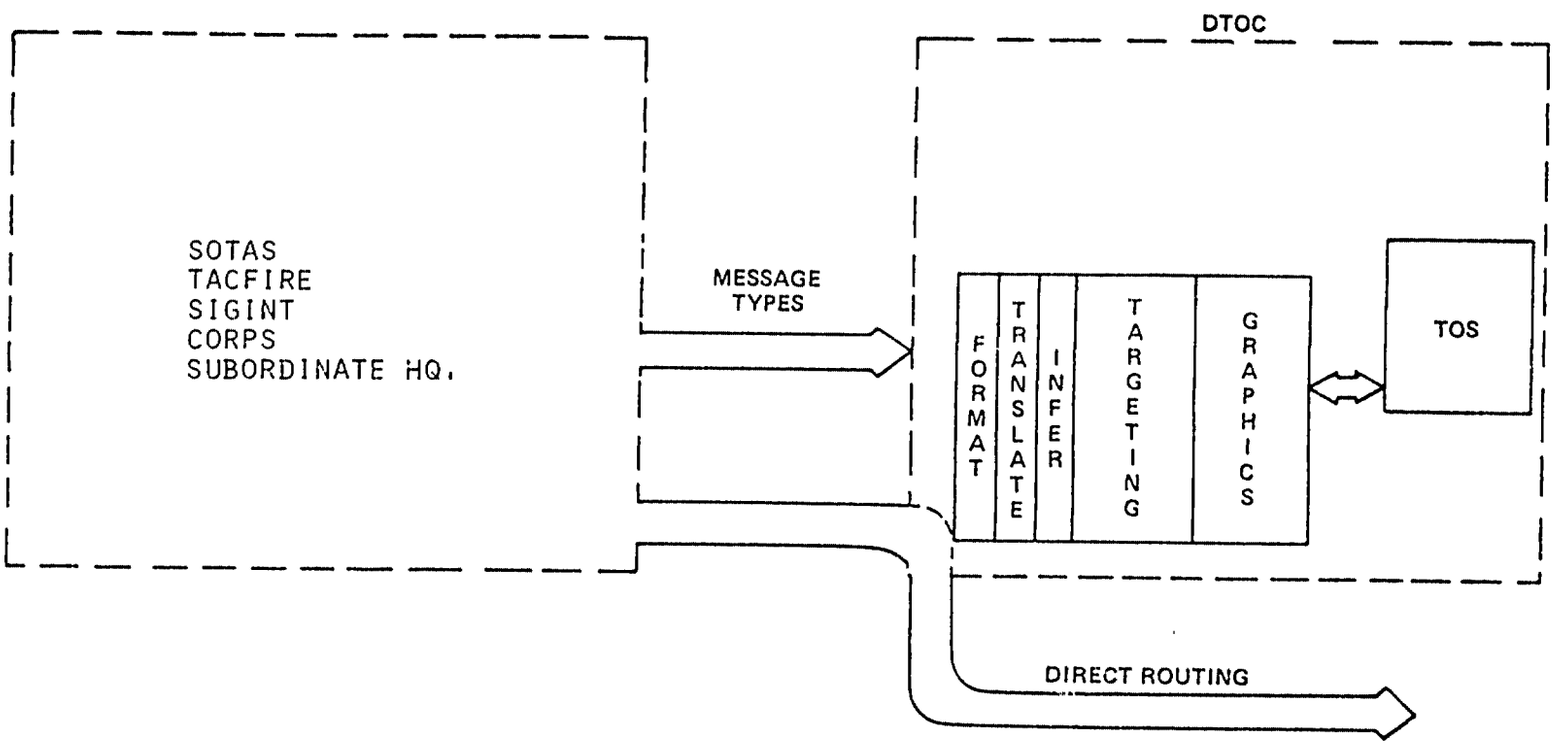
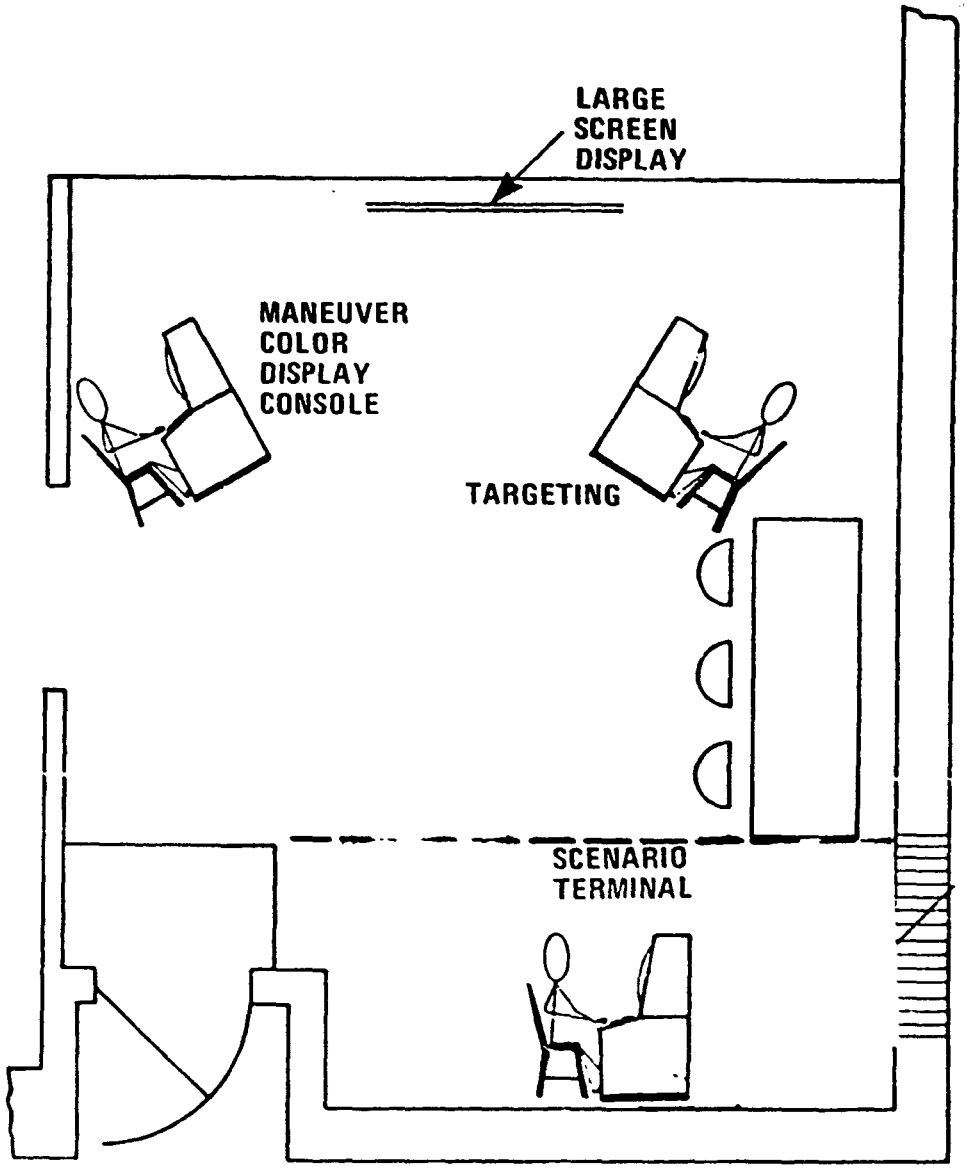


Figure 1.4-1. INFORMATION FLOW AND INTEROPERABILITY.

EXPERIMENTATION CENTER



- NMCC INFORMATION PROCESSING SYSTEM
- DIGITAL TV COLORGRAPHICS

FIGURE 1.4-2. DIVRAS WORKSHOP EXPERIMENTATION CENTER

a graphic and alpha/numeric terminal. The maneuver graphics is a color display console driven by an IBM 1130 computer. The alpha/numeric terminal gives the maneuver analyst access to message traffic and the data base resident in NIPS. The targeting analyst utilizes the alpha/numeric terminal as his major source of data for message readout, and data base queries. This analyst also has a color graphics presentation of target locations and type against a geographic background, the commander is provided a color display which is a direct reproduction of that used by the maneuver analyst. A black and white large screen display viewable by all analysts is incorporated in the center.

A scenario terminal is also provided for message entry and for display of target data on fire missions routed to external systems, such as TACFIRE.

Figure 1.4-3 illustrates the flow of the DIVRAS demonstration. After a presentation of the initial battle situation, key elements of the developing scenario are presented along with target intelligence messages which are derived from the scenario. The DIVRAS test bed processes the message, updates the data base and routes the message, either: externally; to the targeting algorithms; or to the maneuver analyst. In routing to the targeting algorithms the system will either; process the message, determine that a fire mission is warranted, and alert the analyst; or process the message, search the data base for related information, and present it to the analyst for his decision.

The messages provided to the maneuver analyst are used in conjunction with the "mover", "shooter", and "emitter" graphic overlays to allow the analyst and the commander to recognize enemy movement or concentrations and update the maneuver display accordingly.

Figure 1.4-4 indicated the target data routing algorithms which have been developed for the workshop. The first two, Translation and

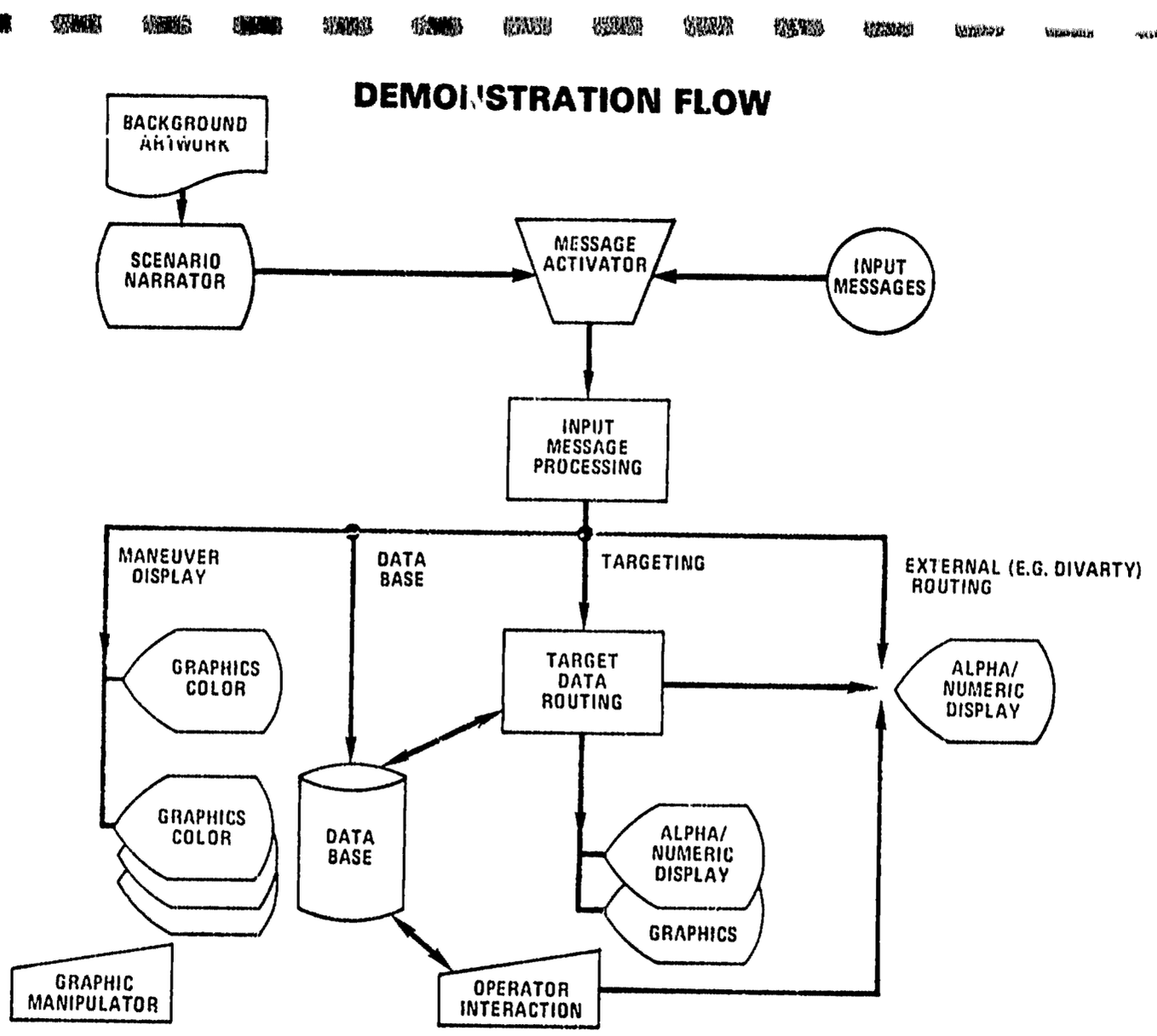


Figure 1.4-3. DIVRAS DEMONSTRATION FLOW.

ALGORITHMS
TARGET DATA ROUTING

TRANSLATE	>	– EASE OF USE FOR ANALYST
INFER	>	– FLEXIBLE INTERFACING
FILTER	>	– REDUCTION IN ANALYST WORK LOAD
CORRELATE	>	– RAPID ROUTING TO WEAPON SYSTEM
ASSOCIATE	>	– PRELIMINARY DATA SEARCH FOR ANALYST
ASSIGN	>	– WEAPON RECOMMENDATION FITTING RULES OF ENGAGEMENT

Figure 1.4-4. TARGET DATA ROUTING ALGORITHMS.

Inference provide for effective interfacing of the five DIVRAS sources and allow for a system to provide information to the analyst in terms that the analyst would use in a manual approach to the same problem. The Filter and Correlation functions reduce the work load on the analyst by filtering out only the target related data in the message stream and providing fire mission recommendations to the analyst for those messages for which sufficient correlating data can be found in the data base to meet the immediate rules of engagement. The final two applications; Associate and Assign, assist the analyst by providing him automatically with data base information that may be related to the incoming message and may be sufficient for the analyst to recommend a fire mission. The Assign function also provides the analyst with a preliminary recommendation on what weapon system is most appropriate for the existing rules of engagement.

All the applications are defined in detail in Section 5 of this report.

Figure 1.4-5 shows the display presentations developed for the commander's maneuver graphics. These consist of: the maneuver display which presents the battlefield situation indicating potential threats and force corrections; real-time adjunct overlays which present accumulated locations of "shooters" "movers" and "emitters"; and a large screen common perception display of the maneuver situation.

Specific data portrayed in each of these presentations is described in Section 6 of this report.

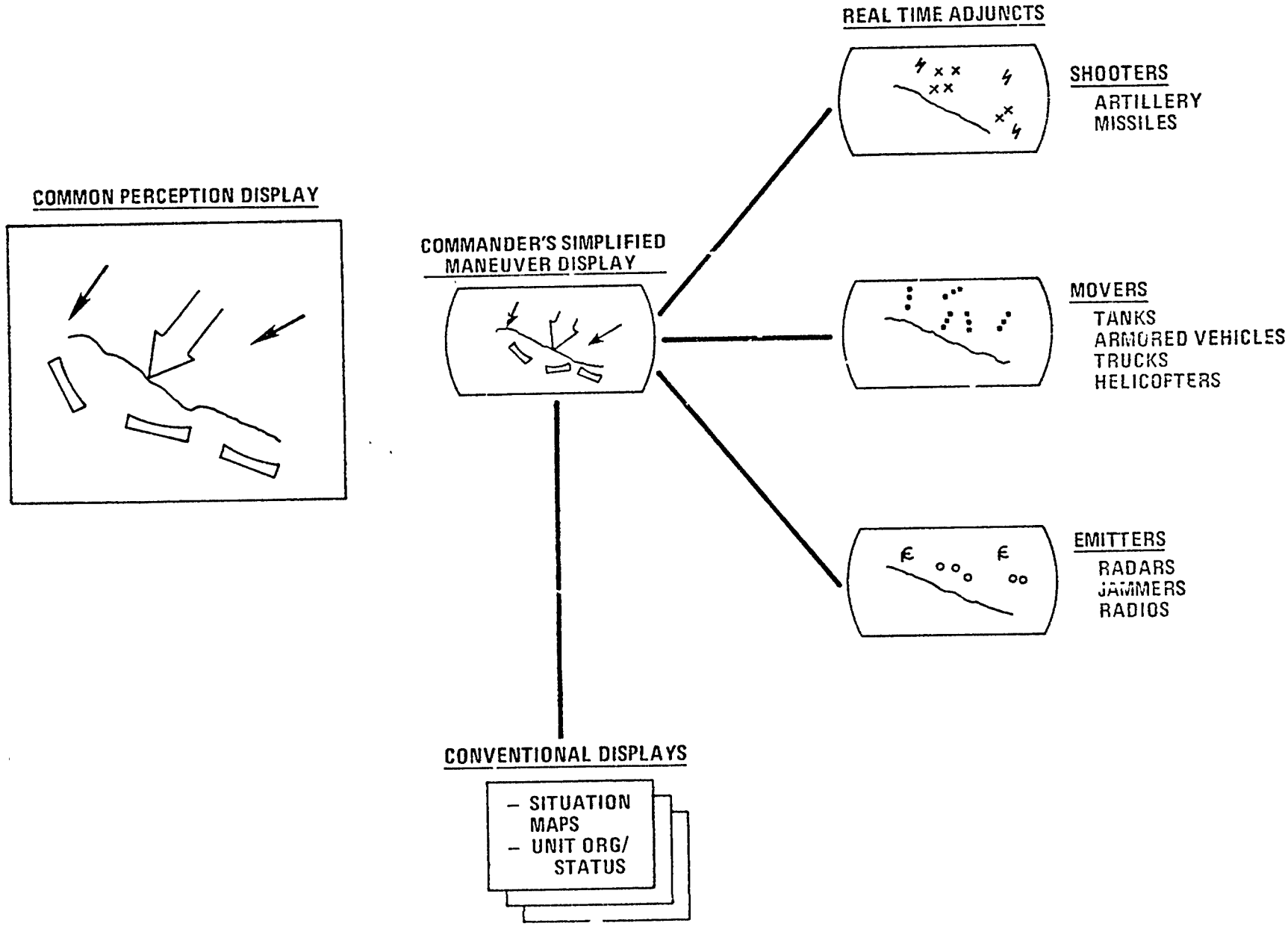


Figure 1.4-5. MANEUVER DISPLAY CONCEPT.

2.0 METHODOLOGY

The objective of the DIVRAS program is to define the real time functional requirements needed to support maneuver display and fires in the DTOC. The approach used in this program is fourfold: to conceptualize the requirements through functional analyses, to implement and experiment with the functions defined, to demonstrate the functions to knowledgeable personnel within the Army, and to document the modified functional requirements.

The methodology for accomplishing this is outlined in Figure 2.1-1. The overall program is divided into three major working areas: an information flow and interoperability analysis; target data routing; and the commander's maneuver display. The program is accomplished in seven major steps as follows:

1. Baseline Concept Review

2. Development of Scenario to produce source data

3. Combat Information Flow analysis of the scenario data through the tactical nodes

4. Development of Target Data Routing algorithms for the DTOC FSE

5. Development of graphical presentation requirements for a commander's maneuver display

6. Experimentation and Demonstration using a commercial ADP workshop facility.

7. Documentation of the functional requirements identified during the program.

METHODOLOGY

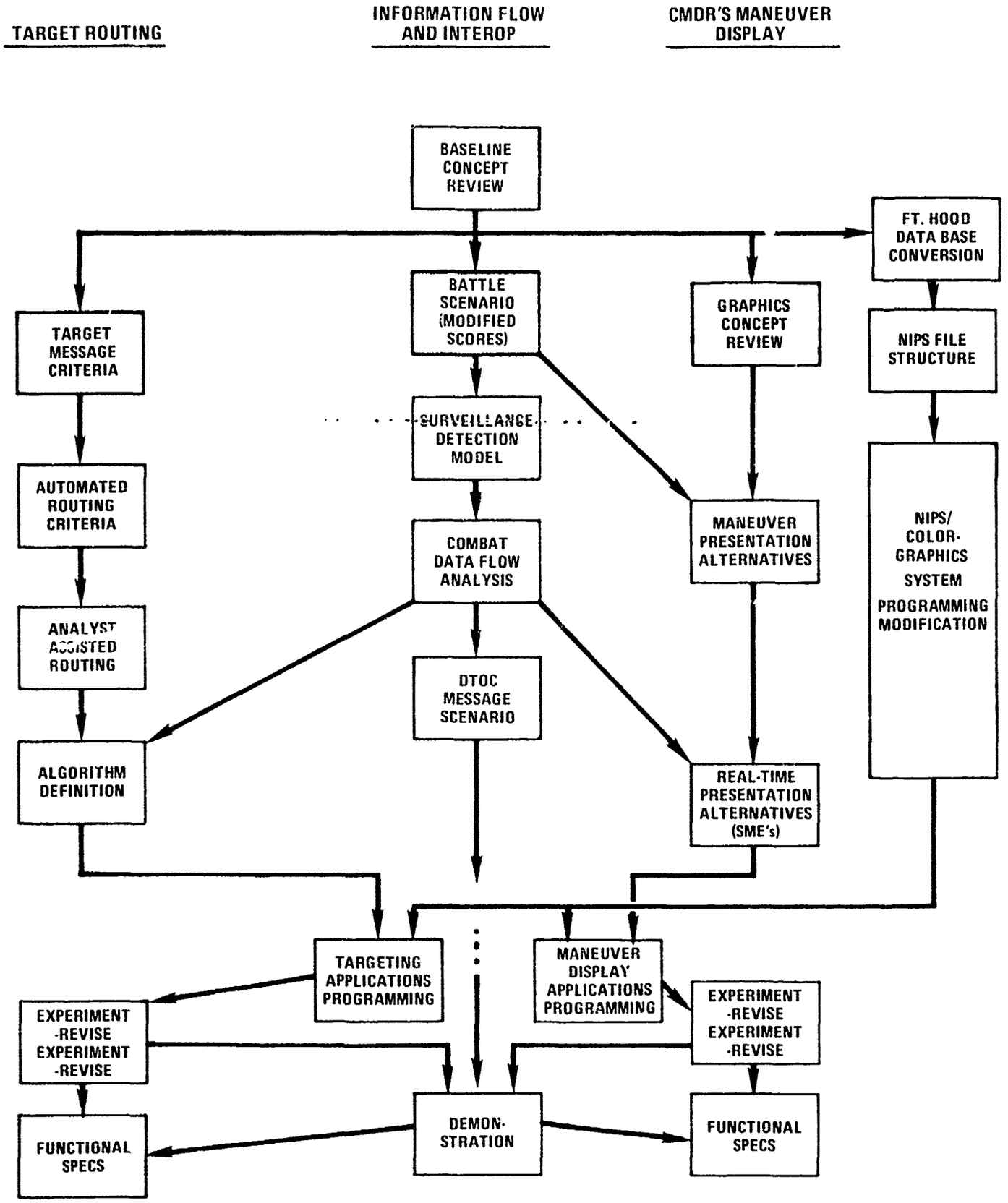


FIGURE 2.1-1. METHODOLOGY

2.1 BASELINE CONCEPT REVIEW

The baseline concept review focused on existing approaches for system interoperability, target data routing, and maneuver display. This review was composed of three major areas: examination of the four major interfaces, TACFIRE, SOTAS, CAC, and Corps; analysis of existing target correlation algorithms; and analysis of existing approaches to the display of tactical data. Documentation and review discussions were initiated regarding SOTAS, TACFIRE, Team Pack, Trailblazer, Guardrail, and Quick Look. Target correlation approaches developed by CACDA within the TACFIRE program were studied. Finally, graphics techniques for tactical data presentation developed by TCATA, the Army Research Institute, CAC, and the U.S. Army Intelligence School were reviewed. Elements and ideas from each of these sources has influenced the development of the DIVRAS functions.

2.2 SCENARIO DEVELOPMENT

The development of real time functional requirements for TOS has been approached by developing a realistic scenario to drive requirements, and to test and evaluate specific functions. The basis for this scenario is the SCORES European situation developed by USACAC. However, the geographic setting and units utilized in the scenario are those which will be exercised in FM222 at Ft. Hood, Texas in 1977. The initial TOS data base for this test has been utilized as the basis for unit task organization at H hour. Since FM222 is a free play two-sided exercise, there is not a precise scenario available. Therefore, specific scenarios have been written to describe the flow of the battle in sufficient detail for data generation. The scenarios described in Section 3 provided 6 hours of maneuver activity, which were played against models of targets, sensors, and friendly units to identify the data traffic which would be generated. This scenario interaction was accomplished partly through manual analysis and partly through ADP generated data.

The result of this segment of the program was a sequential time listing of all sensor/target detections and source reports which could potentially reach the DTOC maneuver or fires elements.

2.3 COMBAT INFORMATION FLOW AND INTEROPERABILITY

Having identified the sensor/target detections and source reports, it was necessary to determine the flow of data from these sources to the appropriate weapon system or command center. An anlysis was performed on the targeting and maneuver information flowing from each source to determine under what conditions it would flow to the DTOC, or bypass the DTOC directly to a weapon system or other node. The criteria for these routing choices were developed for each node in the chain.

A direct result of the analysis of information flow was that the flow depended both on the data content and the rules of engagement as determined at the DTOC. Analysis of the flow and the data needed at each node to support the flow led to a definition of more complete information exchange requirements between the DTOC and the principal source nodes.

2.4 TARGET DATA ROUTING

The approach to developing the real-time function for target data routing at the DTOC centered on being able to identify and correlate multiple messages from different sources and provide hard target data to a weapons system. This analysis involved developing criteria for the following:

1. How to automatically identify messages with target data content

2. Providing the target analyst with a flexible control on what target data is processed and displayed

3. Developing algorithms for automatically correlating multiple source inputs and recommending fire missions

4. Assisting the analyst in correlating multiple source inputs to identify targets

5. Utilizing the real time rules of engagement established by the commander to recommend a weapon system to address the correlated target.

The analysis of the above criteria resulted in algorithms which have become the basis for the real time target data routing function in DIVRAS.

2.5 COMMANDER'S MANEUVER DISPLAY

The objective of the analysis of the commander's maneuver display is to specify a simple presentation which will give the commander a real-time interpretable picture of what is happening on the battlefield. The key concept used in the development of these display requirements is that a real time graphic presentation of data from target acquisition sensors, together with a simplified combat symbology can provide this picture. Further, the concept is driven by the premise that presenting sensor data in categories of "shooters", "movers", and "emitters" would be a most useful and effective approach. The analysis centered on defining specific requirements for geographic background, symbology, and graphic manipulation capability.

Geographic background considerations focused on whether a detailed field map type or background was required; or whether something simpler would be desirable.

The symbology question focused on how detailed unit identification should be and how red and blue forces should be portrayed, so as to represent the battle situation accurately.

The manipulation question focused on what capabilities should be given the maneuver analyst to manipulate the graphics presentation for presentation to or modification by the commander.

2.6 EXPERIMENTATION

There are two phases to the experimentation task in the DIVRAS program. The first is workshop review with knowledgeable U.S. Army personnel of the concepts, capabilities, and requirements of the DIVRAS experimental implementation. This consists principally of review of symbology, and geographic portrayal for the maneuver graphics. In the case of targeting the key consideration is an evaluation of the logical algorithms used for target correlation.

The demonstration portion of the program consists of concept review by higher level officers. This is accomplished by demonstrating the concept within a battle scenario to show the types of graphics the commander would be shown and the targeting decisions which are made in real time.

2.7 FUNCTIONAL DEFINITION

The final task in the program is to document the final functional requirements in a structured form for real time targeting and maneuver display. The functions demonstrated during the experimentation phase will be documented with modifications and enhancements which are determined from the workshops and demonstrations. The functional descriptions developed will be prepared without restricting their implementation to any single predefined computer, programming language, or data base manager system, but will allow thorough technical understanding of the application design concept.

3.0 SCENARIO AND SENSOR DATA DEVELOPMENT

The following subparagraphs and their related appendices discuss in detail the DIVRAS Experimentation Scenario. Also described is the method used to simulate friendly sensors and enemy force movement to develop sensor target data, and maneuver source reports.

3.1 SITUATION OVERVIEW

3.1.1 Background

Following several years of hostilities, the US-Aggressorland Border was established by Armistice in 1964. In the ensuing thirteen years, the aggressor systematically upgraded and modernized his forces. Aggressorland's attitude toward the US during this period fluctuated between periods of "Peaceful coexistence" and those of saber-rattling anti-US propaganda. Relations between the two countries have grown progressively worse during the past year.

Figure 3.1-1 shows the border location between the two countries. The enemy has numerous garrison locations in the Ft. Worth area. Overall enemy unit strength is estimated at 95-100%. Highway 199 is the international border between the two countries.

On 7 February Aggressorland announced that division-level training exercises would be conducted during March in two newly established training areas adjacent to the US-Aggressorland border.

By 9 February high-level sources indicated that the scope of preparations exceeded that necessary for division-level tactical training

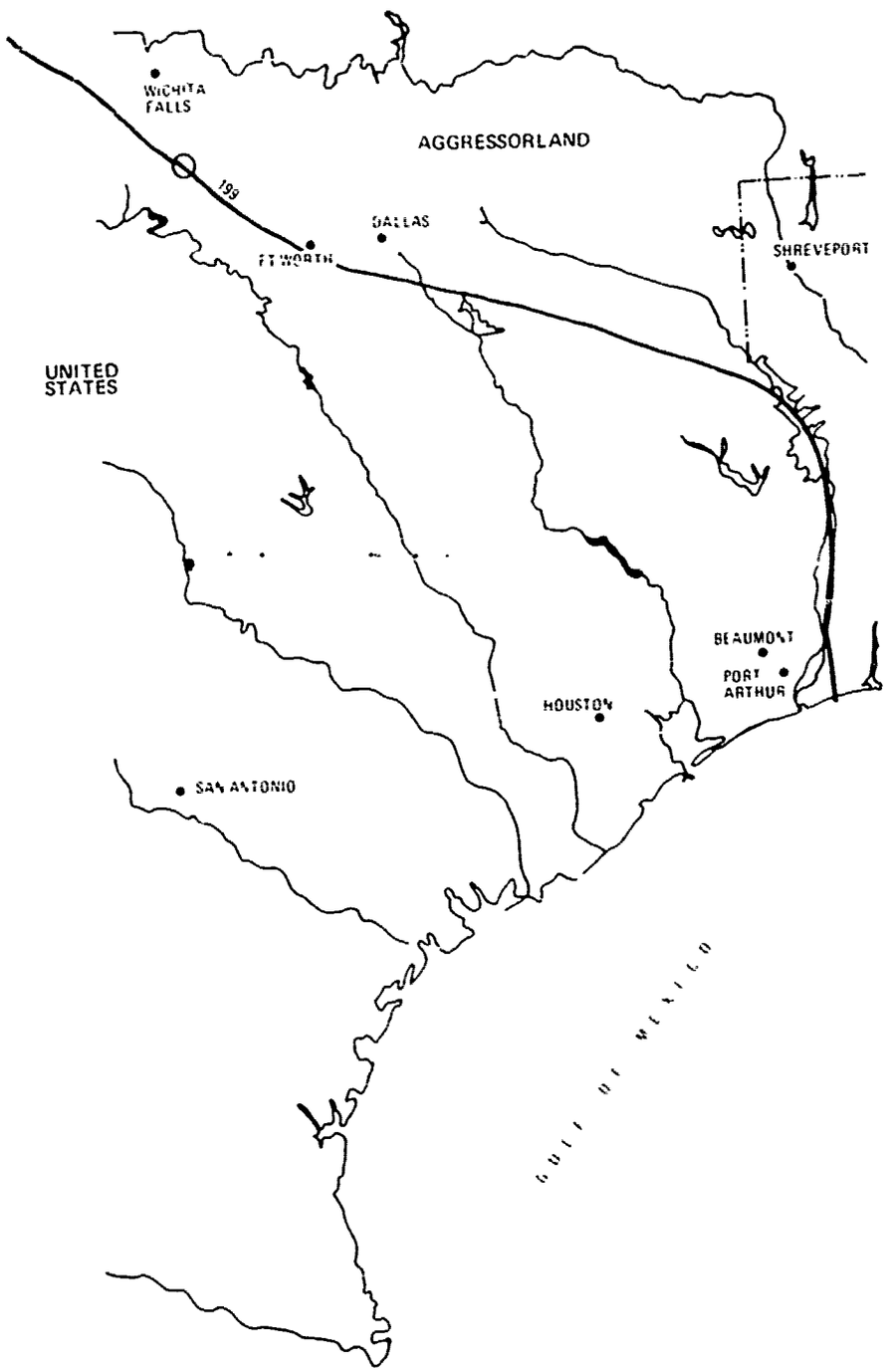


Figure 3.1-1. BORDER LOCATION BETWEEN U.S. AND AGGRESSORLAND.

exercises. Agent reports and higher headquarters intelligence reports revealed that a high-security zone has existed in vicinity of Nocona (PN 1839) since 15 February. Civilians have been relocated from the area and military traffic entering the area has been significantly greater than that exiting the area. Equipment noted entering the security area includes suspected long range communications equipment, radar and air defense associated equipment. Rail traffic between Ringgold (NN 9842) and Bridgeport (PM 1775) has been extremely heavy since 14 February. Most observed traffic consists of self-propelled artillery pieces carried on flat cars. A large open-air suspected ammunition storage area is located in the vicinity of the Ringgold railhead. Heavy military and civilian truck traffic has been observed moving to Ringgold on Route 81 from north of the Red River since 13 February.

Joint Task Force Central Texas Command (JTFCTC), composed of 1st, 2nd and 3rd Corps was alerted to move to border defense positions as a precautionary measure.

1st Corps moved the 23rd Armored Division and the 52nd Mechanized Division into prepared defensive positions. The 53rd Mechanized Division was placed in Corps reserve; the 171st ACCB and the 20th Infantry Division were ordered to move from Arizona to join 1st Corps.

3.1.2 Battle Description

On March 6, 1977 the aggressor attack is initiated on the central front by four enemy armies; the 12th, 5th and 6th Combined Arms Armies (CAA), and the 1st Tank Army. The main attack in the area of the U.S. I Corps is carried by the 1st Tank Army along with divisions of the 5th and 6th Combined Arms Armies on its flanks. Figure 3.1-2 indicates the initial attack on D-Day. The 101 and 80F Tank Divisions (TD) along with

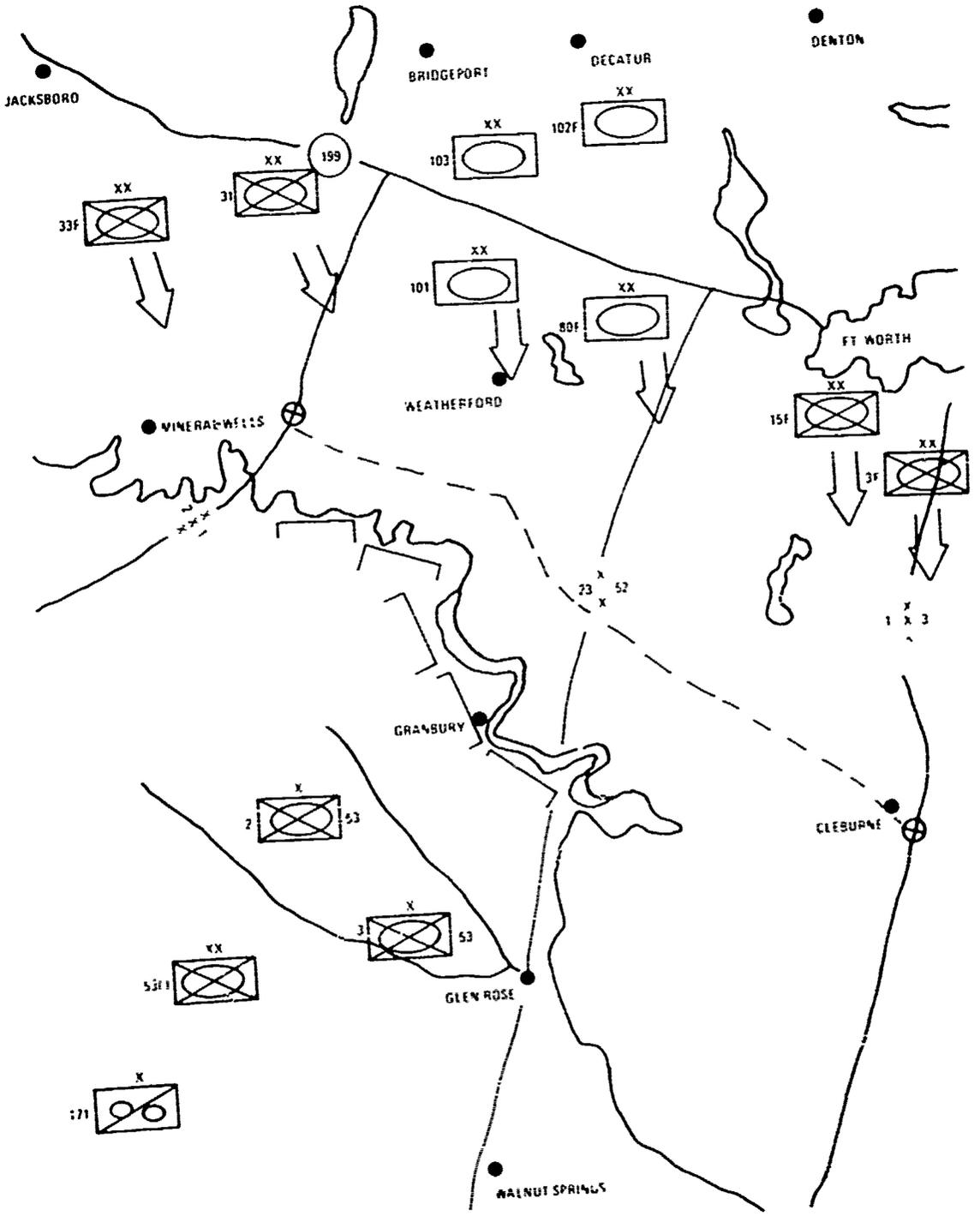


Figure 3.1-2. D DAY.

the 31 Motorized Rifle Division (MRD) have engaged forward elements of the U.S. 23rd Armored Division. The enemy's 33F MRD is also engaged with certain elements of the 23rd Armored Division. In the area of the U.S. 52nd Mechanized Division (MD) the enemy 15F and 3F Motorized Rifle Divisions have advanced rapidly toward the south. The 102F and 103 Tank Division of the 1st Tank Army have remained in reserve just across the international boundary.

Both the 23rd and 52nd U.S. Divisions have defenses in depth. The main line of defense for the 23rd Armored is the southwestern side of the Brazos River. In the 52nd Division sector the terrain to the east of the river is more favorable for defense and the main line of defense has been established on a generally east-west line between Glen Rose and Cleburne.

D+1

By the second day of the battle (Figure 3.1-3) the enemy forces have made rapid progress in the 52nd Division sector and in the eastern sector of the 23rd Armored. The enemy's 101, 80F, and 15F Divisions have begun to move southeast in an attempt to exploit the rapid advance in the east and to seek more favorable terrain for the attack south of Granbury. The covering force of the 23rd Armored has been extremely effective in stalling the advance of the enemy's 33F and 31st Motorized Rifle Divisions. However, the enemy's intent to circumvent main defense points to the northwest of Granbury has become apparent.

The enemy army commander has also sought to exploit the rapid progress in the eastern sector of the U.S. I Corps by moving the reserve divisions (102FTD and 103TD) to the southeast.

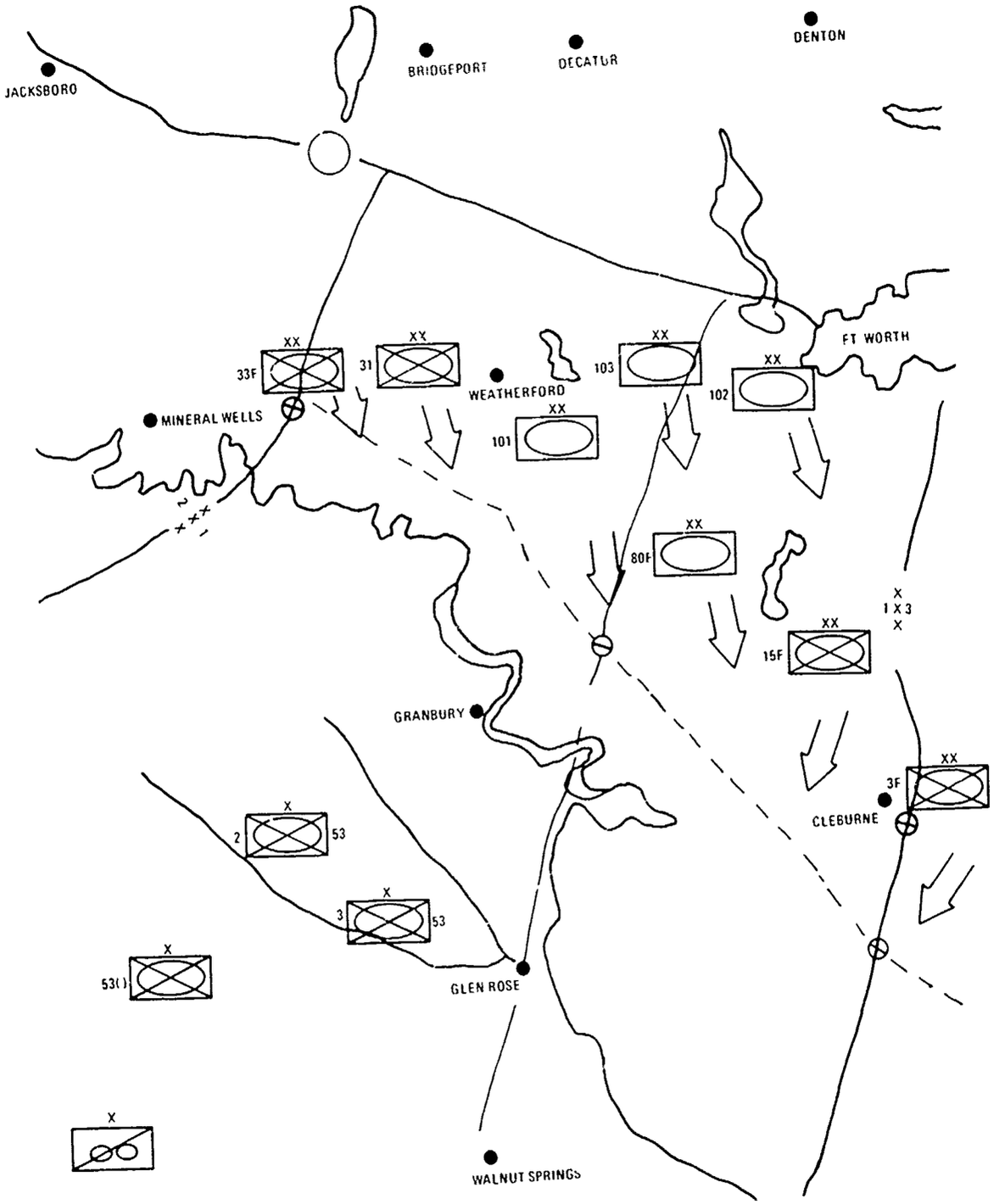


Figure 3.1-3. D+1.

D+2

Figure 3.1-4 indicates the situation on D+2. The enemy has made rapid progress to the southeast of Granbury. The 1st Tank Army Commander has committed the 103TD in an attempt to force a breakthrough across the Brazos River and circumvent the main defense line of the 23rd Armored.

The U.S. I Corps commander has recognized this danger and committed the 53rd Mechanized Division. The 53rd Division has assumed responsibility for the FEBA from the areas south of DeCordova Bend southeast to Highway 174, a front of approximately 30 kilometers. In doing so the 53rd MD has regained operational control of the 1 BDE/53 and assumed operational control of the 3 BDE/23. The 53rd Division is on line when the initial attack by the 103TD begins on D+2.

D+3

Figure 3.1-5 indicates the situation at 0330 on D+3. The 53rd Division is now faced by three aggressor divisions, the 103TD, the 80FTD and the 15F MRD. The attack by the 103TD on D+2 has resulted in two regiments of the 103 being established on the west side of the Brazos River. Advances by the 80F and 15F Divisions have been limited, however, the initiative has been maintained by the enemy.

The 53rd Division commander has contained the attack by the morning of D+3, through rapid repositioning of forces laterally. The key threat is still posed by the 103TD which is opposed by the 2 BDE/53. The enemy has maintained pressure on the 23rd Armored with the 33F and 31st Motorized Rifle Divisions north of Granbury. To the south of Granbury the 101TD has made modest advances. The 1st Tank Army of the enemy has retained the 102F Tank Division in reserve east of Cleburne.

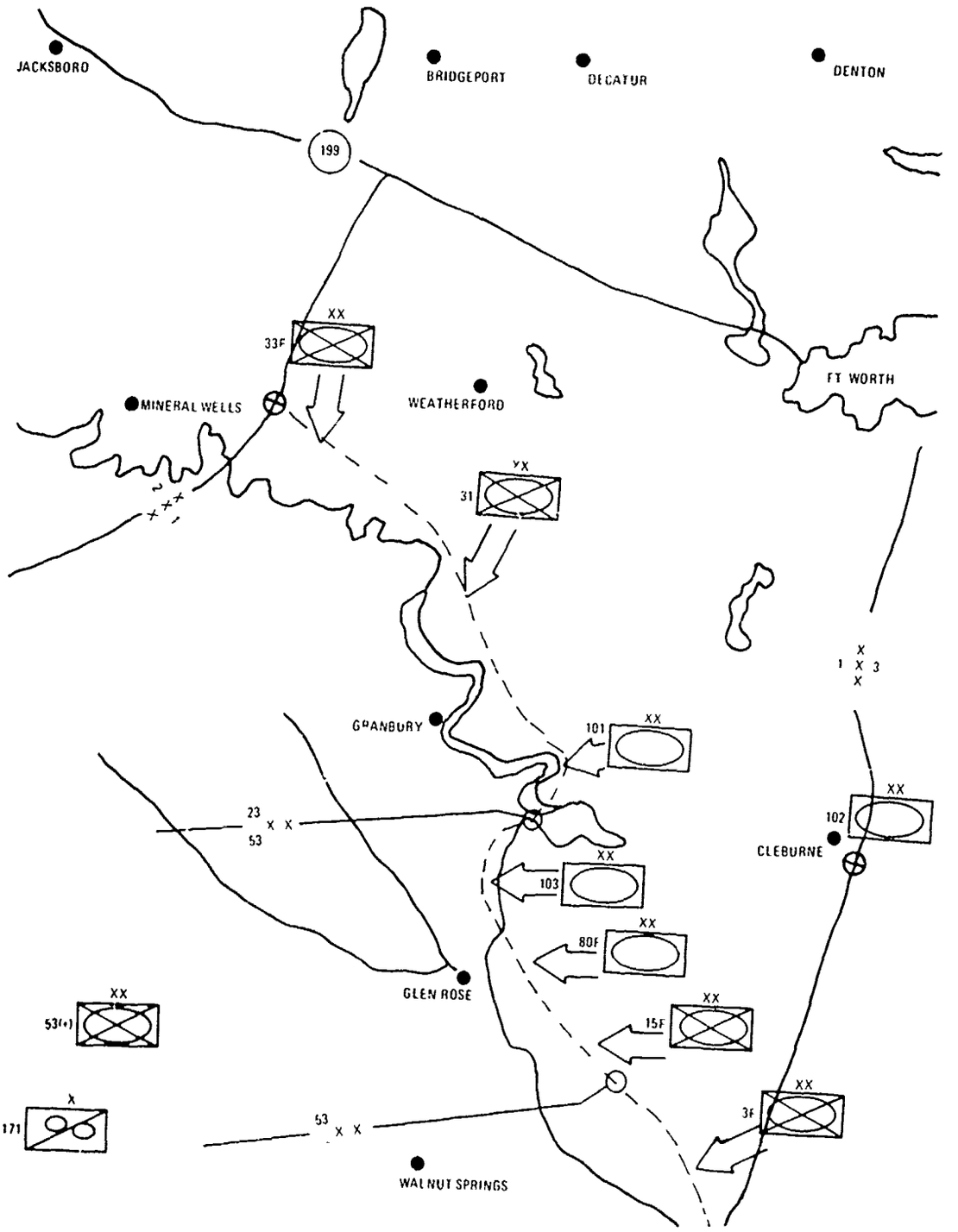


Figure 3.1-4. D+2.

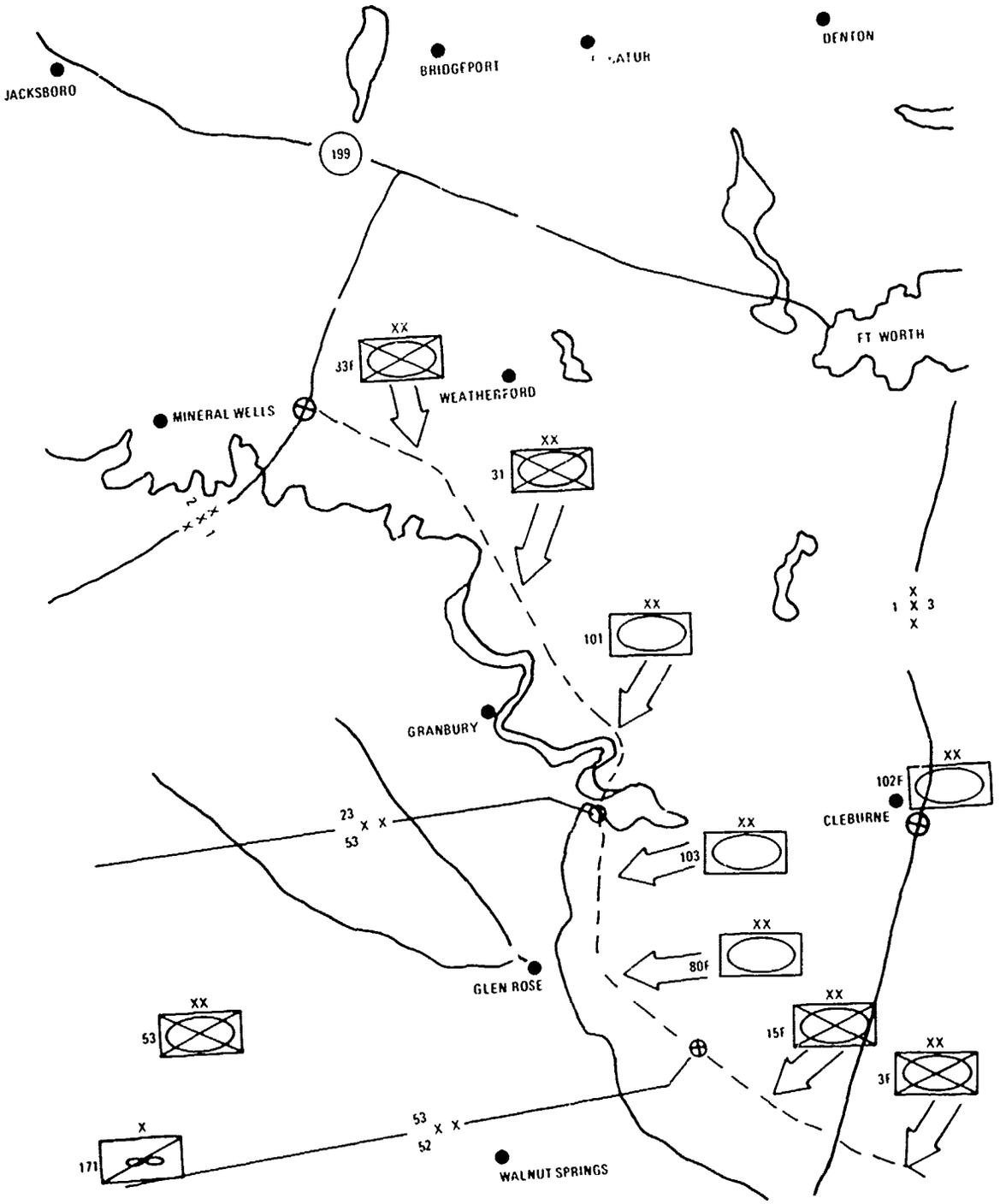


Figure 3.1-5. D+3 0330.

3.2 DIVRAS EXPERIMENTAL SCENARIO

The DIVRAS experimental scenario was developed to provide a tactical situation framework with which to evaluate and demonstrate various aspects of division level display and target routing requirements. SCORES (Army Scenario Oriented Recurring Evaluation System) was used as a guide for development of the DIVRAS experimental scenario. However, in order to avert the problem of dealing with classified tactical situations and data but not lose realism and validity, the Ft. Hood data base was used to initialize the system. This meant that the location for the simulation became the Ft. Hood area of Texas and the friendly and enemy tactical elements were changed to match the data base. The scenario is divided into the following subscenarios:

Subscenario 1 - Blunting 103 TD Penetration
Subscenario 2 - Containing 80F TD Flanking Attempt
Subscenario 3 - Containing 15F MD Advance
Subscenario 4 - General Road Traffic
Subscenario 5 - Recognition of 2nd Echelon Threat

3.2-1 General Situation

The DIVRAS subscenarios are concerned with the operational tactical situation, that occurs between 0330 hours and 0915 hours on D+3, in which the enemy 103 TD, 80F TD, and 15F MD mount an intensive simultaneous attack against elements of the U.S. 53rd Mechanized Division. Figures 3.2-1 and 3.2-2 project an overall timeline and key events that cover the friendly and enemy force actions during this time period.

The 103 TD penetration is spearheaded by the 64 TR supported by the 65 TR on the north flank and by the 204 MRR on the south flank and backed up by a ready reserve represented by the 33F TR. By 0500 hours leading

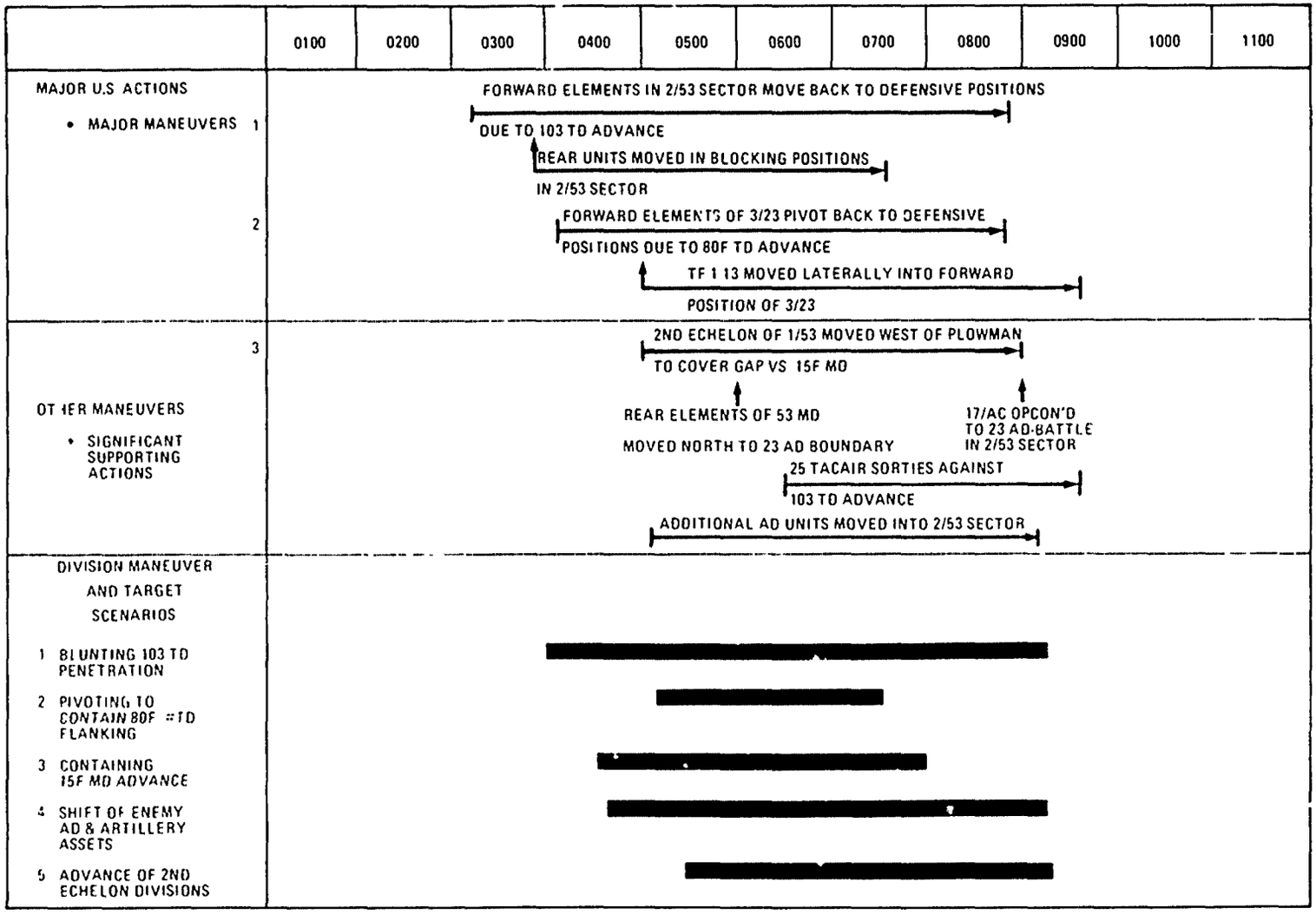


Figure 3.2-1. TIME LINE VS MAJOR EVENTS FOR U.S. FORCES.

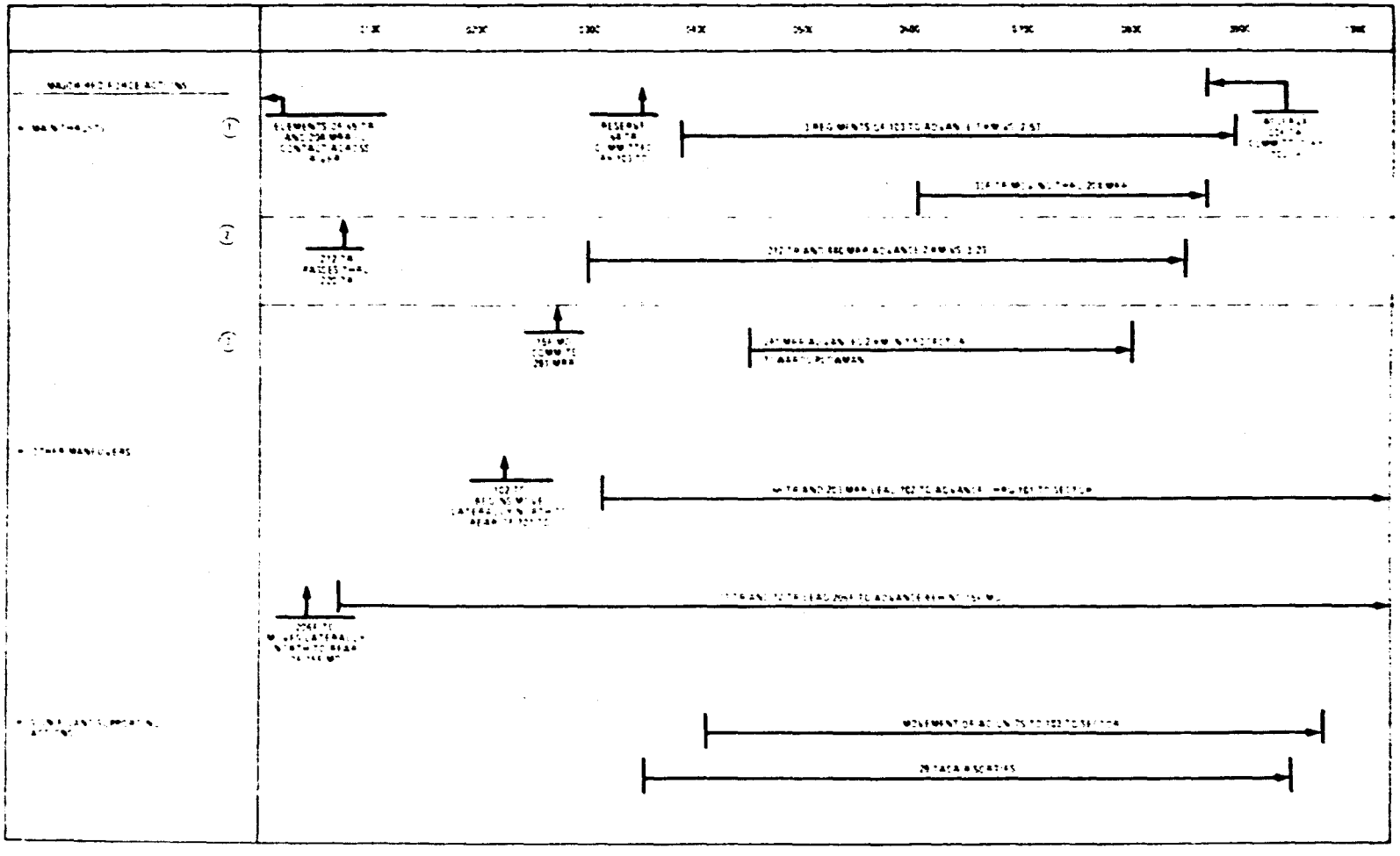


Figure 3.2-2. TIME LINE VS MAJOR EVENTS FOR RED FORCES.

elements of the 64 TR, supported by a heavy artillery barrage, have crossed the Brazos River against the maneuver battalions of the 2BDE/53, i.e., 1-6/AR, 1-8/AR, 2-26/Mech, 1-23/AR, and 1-86/Mech. Through subsequent withdrawals to prepared defensive positions, heavy artillery support, and an air assault attack on enemy positions by the 171 AACB, the enemy penetration in the 2 BDE/53 sector was effectively blunted and contained by approximately 0900 hours.

At 0600 hours, the 80F TD, using the 212 TR and the 440 MRR regiments, had aggressively launched an attack on the 3 BDE/23 and 3 BDE/53 sectors of the 53rd Mechanized Division, while holding the 220 TR and the 213 TR regiments in reserve. The brunt of the attack is borne by the 1-15/AR and 1-95/Mech battalions, which subsequently withdrew to prevent flanking by the 440 MRR in the 3 BDE/23 sector with the G-31/AR and 1-13/AR battalions being located in prearranged blocking positions. The 1-14/AR maintains its defensive position throughout the period. 1-9/AR displaced from a position in the 3 BDE/53 sector to a more defensible position in the 2 BDE/53 sector. Net result is that by 0900 hours the forward movement of the 80F TD had been halted.

At 0400 hours, the 15F MD, using the 281 MRR and 282 MRR regiments, was aggressively attacking the U.S. 1-58/Mech and 1-84/Mech battalions in the 1 BDE/53 sector. Subsequently, the 15F MD committed 278 TR to support the attack by the 281 MRR while still holding the 283 MRR in reserve. By 0600 hours the 1-58/Mech and 1-84/Mech battalions had withdrawn to prepared defensive positions east of the Brazos River, and by 0715 hours the 2-37/AR battalion had assumed its assigned blocking position behind the 1-58/Mech and the 1-84/Mech. By 0900 hours the advance of the 15F MD had been contained and halted.

3.2.2 Unit Organization and Disposition

The unit or troop lists for the friendly and enemy forces used to support the DIVRAS experimentation scenario are contained in Figures 3.2-3 and 3.2-4, respectively. The map in Figure 3.2-5 shows the basic disposition of the friendly and enemy forces and the FEBA as of 0930 hours on D+3.

3.2.3 Timelines and Sequential Narratives

This subsection contains a detailed timeline of U.S. and Red Force actions for each of the five subscenarios. These timelines are contained in the following five figures:

(1) Fig. 3.2-6, Subscenario 1 - Blunting Main Force Penetration
(2) Fig. 3.2-7, Subscenario 2 - Containing 80F TD Flanking Attempt
(3) Fig. 3.2-8, Subscenario 3 - Containing 15F MD Advance
(4) Fig. 3.2-9, Subscenario 4 - General Road Traffic

Subscenario 4 is concerned with aggressor general road traffic to the rear of the front line elements during the period of 0400 to 0900 hours. The traffic is assumed to be normal administrative and logistic support for the engaged units and that of reinforcements moving up to support the aggressor attack. Figure 3.2-9 shows the different road segments used in this scenario. These road segments together with the mover traffic reported/detected in the other subscenarios were used to build the moving targets for sensor acquisition.

(5) Fig. 3.2-10, Subscenario 5 - Recognition of Second Echelon Activities.

I CORPS

53 MECHANIZED DIVISION
20 INFANTRY DIVISION
23 ARMORED DIVISION
14 ACR
171 AACB
52 MECHANIZED DIVISION
2-461 ADA
2-462 ADA

53RD MECHANIZED DIVISION

1-24 CAVALRY
502 EN BATTALION
53 MECH DISCOM
53 S-T
53 SIG
53 ENGR
53 MED
53 ORD
53 FIN
53 AG
53 MP
53 SE
236 MT
53 AVN
53 CDTI

1-52/23 FA (attached)
2-40 FA
2-41 FA
2-42 FA
2-43 FA
1-17/52 FA (attached)
2-71/52 FA (attached)
2-72/52 FA (attached)
2-73/52 FA (attached)
1-55/23 FA (attached)
1-57/23 FA (attached)

1 BDE/53
1-6/AR
1-84/MECH
1-85/MECH
1-86/MECH
2-37/AR/23 (attached)
1-58/MECH

2 BDE/53
1-7/AR
1-8/AR
1-66/MECH
2-26/MECH/52 (attached)
1-23/INF/52 (attached)
2-44/MECH/.3 (attached)
3-36/AR/23 (attached)
1-44/AR/23 (attached)

3 BDE/53
1-9/AR
1-87/MECH

3 BDE/23 (attached)
1-95/MECH
1-11/AR
1-14/AR
1-15/AR

Fig. 3.2-3. PARTICIPATING FRIENDLY TROOP LIST

5 CORPS/MECHANIZED

3F MD
- 16 MRR
- 17 MRR
- 18 MRR
- 46 TR
- 3F/DAY

15F MD
- 325 SIG
- 281 MRR
- 278 TR
- 282 MRR
- 15F/DAY
  - 154/RGT/FA
  - 61/BN/RL
  - 81/BN/FROG

1 CORPS/AR

101F TD
- 202 MRR
- 62F TR
  - 673 TB
  - 674 TB
  - 675 TB
- 63 TR
  - 644 TB
  - 645 TB
  - 646 TB
- 32 TR
- 101/DAY
  - 129/FA/RGT
  - 50/PL/BN
  - 50/FROG/B

102F TD
- 203 MRR
- 36 TR
- 66 TR
- 67 TR
- 102/DAY
- 227/RGT/SA-6

103F TD
- 201 MRR
- 33 F TR
- 64 TR
- 65 TR
- 103/DAY
- 231/RGT/SA-6

80F TD
- 212 TR
- 213 TR
- 223 TR
- 440 MRR
- 80F/DAY
  - 212/RGT/FA
  - 212/BN/RL
  - 212/BN/RL/MR
  - 83/BN/FROG
- 235/BN/SIG
- 224/BDE/ADA

12 CORPS/MECHANIZED

171F MD
172F MD
191F MD
202F TD
206F TD
- 11 MRR
- 12 MRR
- 200/DAY
  - RGT/SA-6
  - BN/FROG

Fig. 3.2-4 PARTICIPATING ENEMY TROOP LIST

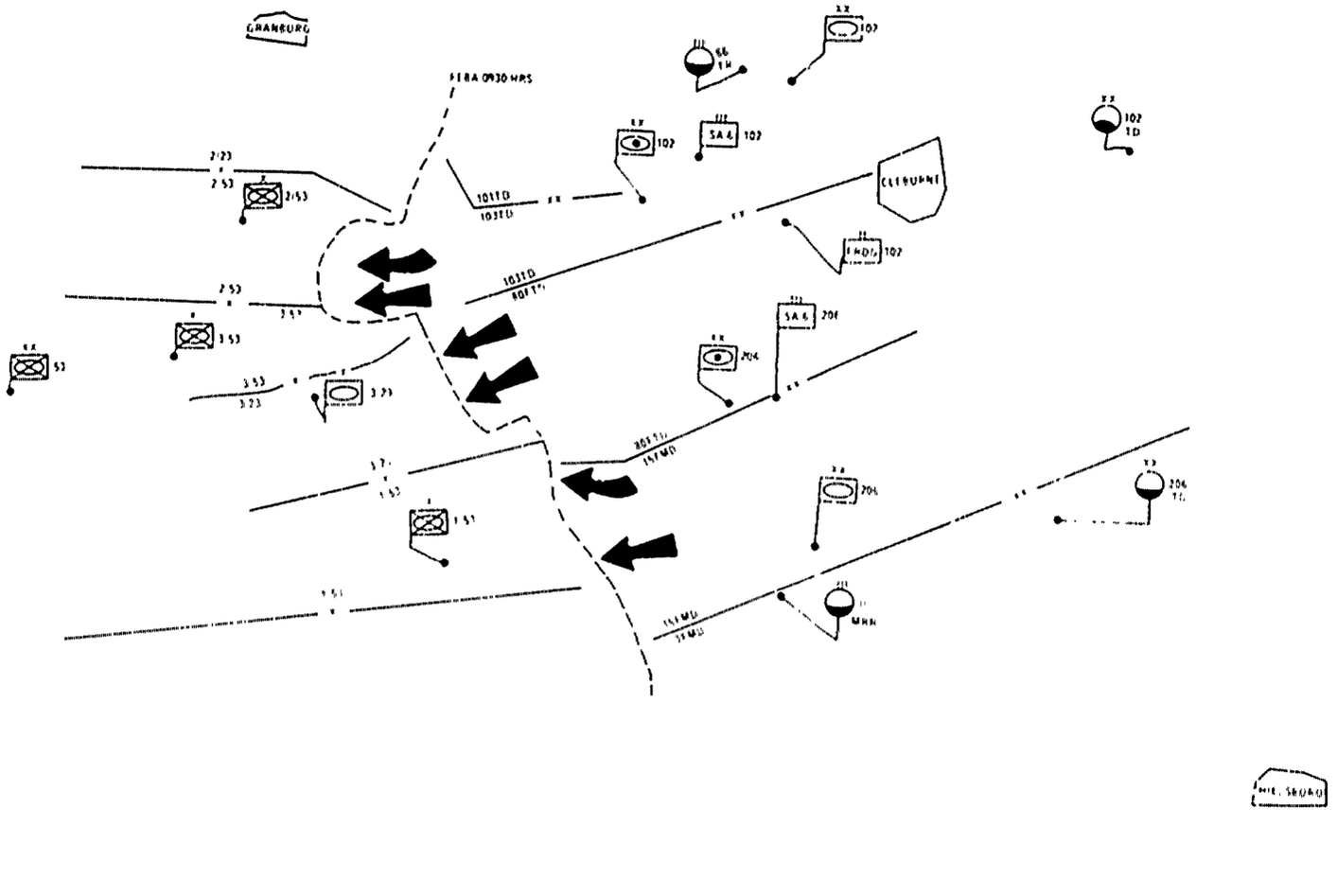


Figure 3.2-5. ENEMY AND FRIENDLY TROOP DISPOSITIONS AS OF 0930 HRS D+3.

TIME	RED FORCE ACTIONS	U.S. ACTIONS
0330	64 TR Located at PL240757 committed by 103 TD.	2/53 moves TF 1-86 from blocking position (PL160744) to line between TF 1-23 and TF 1-9
0400	64 TR passes between 65 TR and 204 MRR with lead elements at PL220744.	
0415		TF 1-86 in position at PL185719.
0500	Lead elements 64 TR across Brazos River at PL210734.	
0515	Artillery barrage by units of 101 TD and 80 F TD commences against 2/53 and 1/23.	
0530	Lead elements of 64 TR in line in position at PL190734	FA 2-40, FA 1-57, and FA 1-52 begin counterfire against 80F TD artillery.
0535		FA 1-55 begins counterfire against 101 TD artillery.
0600	103 TD resumes attack in 2/53 sector with 2 mech BNS of 64 TR leading thrust. 65 TR and 204 MRR move forward in concert. -2 lead BNS of 64 TR @ PL190734. -2 lead BNS of 65 TR @ PL200704. -2 lead BNS of 204 MRR @ PL200724.	
0645	Red Air Force initiates 15 sorties against 2/53 in support of 64 TR.	
0650		2/53 moves TF 1-44 from PL190734 into blocking position between TF 1-23 and TF 1-86 in response to 64 TR rapid penetration.
0700	64 TR initiates CP relocation from PL230744 in preparation for rapid advance.	Division Commander order 3/53 to relocate CP to rear in light of 64 TR advance.
0705	80F TR advances from PL255739 towards Brazos River in preparation for crossing and rapid exploitation of penetration.	
0710	204 MRR commits a third mechanized battalion to assure lodge [illegible] by 64 TR rapid ad vance (moved from PL205724 to PL190714).	Division Commander orders FA 1-55, 1-57, and 2-42 be reordered to support 2/53 against 64 TR penetration. FA 1-17 and FA 2-40 reordered to support 3/23 sector.
0715		Division orders 2-441 to move additional SHORAD (C/U) Battery (D-2-441) from PL000694 into position to support 3/23 sector.
0720		Division Commander requests 2-461 AD BN fires be reordered to support 53 MD.

FIGURE 3.2-6 SUBSCENARIO 1 - BLUNTING MAIN FORCE PENETRATION

TIME	RED FORCE ACTIONS	U.S. ACTIONS.
0730	Red Air Force initiates 10 sorties in support of 65 TR in 2/53 sector.	Division Commander requests all allocated CAS sorties be directed to blunt 64 TR penetration.
0800	65 TR commits third mechanized battalion to 1st Echelon to improve progress of advance (located at PL210754).	
0810		TF 1-44 in place at blocking position PL130744.
0815		[illegible] sorties initiates against 64 [illegible] area.
0830	64 TR CP in place at PL210754.	
0840	Third of 65 TR's Battalions enters line at Brazos River PL190759.	20 Attack Helo sorties initiated against 64 TR Battalions in area PL[illegible]714.
0845	Lead elements of 33F TR (reserve of 103 TD) at Brazos River. PL217734.	3/53 CP in new position at PL0[illegible]672.
0900	103 TD halted by units of 2/53, 3/53, TACAIR and Attack Helo sorties. -Lead Bn's of 64 TR at PL180724. -Lead Bn's of 65 TR at PL1[illegible]754. -Lead Bn's of 234 MRR at PL190714.	
0915		D-2-441 (C/V) SHORAD Battery at PL100672.

FIGURE 3.2-6. SUBSCENARIO 1 - BLUNTING MAIN FORCE PENETRATION (CONT'D)

TIME	RED FORCE ACTIONS	U.S. ACTIONS
0400	212 TR ENTERS FRONT LINE OF 80F TD AT PL2[illegible]639	
0415	212 TR SENDS RECONNAISSANCE PATROLS TO DETERMINE U.S. STRENGTH AND POSITIONS IN THE AREA OF PL250674	
04[illegible]0		RECONNAISSANCE UNITS OF 3/23 REPORT THE PRESENCE OF NEW REGIMENT IN THE AREA OF PL250678
0530		3/23 COMMANDER ORDERS TF 1-95 TO MOVE NORTH FROM PL250679 TO POSITION ON [illegible] SUSPECTED LOCATION OF NEW ENEMY REGIMENT B COMPANY OF TF 1-95 TO REMAIN IN DEFENSIVE POSITIONS AT PRESENT LOCATION
0600	212 TR BEGINS ATTACK WITH LEAD BATALLIONS FROM PL258686 WITH LIMITED OBJECTIVE OF REACHING [illegible]BRELL (PL25[illegible]674) AND OCCUPYING 3/23 UNITS 440 MRR ADVANCES FROM PL290675 WITH IMMEDIATE MISSION TO SECURE FLANK OF 212 TR	
0620		TF 1-95 IN DEFENSIVE POSITIONS AT PL255676 OPPOSITE 212 TR
0645	80F TD COMMANDER NOTING SHIFT OF TF 1-95 NORTHWARD ORDERS 440 MRR TO ACCELERATE ADVANCE AND ATTEMPT FLANKING MANEUVER TO THE SOUTHWEST FROM PL291676	
0650	212 TR AT PL247686 ORDERED TO ACCELERATE ATTACK AND TIE DOWN TF 1-95 AND OTHER FORCES TO THE NORTH	
0710		TF 1-95 IN HEAVY CONTACT WITH LEAD BATTALIONS OF 212 TR AT PL255678
0715	440 TR REACHES PL280664 WITH LIGHT RESISTANCE FROM ELEMENTS OF B COMPANY, TF 1-95	
0720		53 MD COMMANDER ORDERS 3/23 TO PIVOT FRONT LINE BATALLIONS BACK ALONG NORTH/SOUTH LINE ANCHORED BY TF 1-14 IN ITS PRESENT POSITION (PL228695) TO PREVENT FLANKING BY 80 FTD
0725		3/23 BDE COMMANDER ORDERS TF 1-15 TO MOVE SOUTHWEST FROM PL240696 TO DEFENSIVE POSITIONS IMMEDIATELY SOUTH OF TF 1-14 AND TF 1-95 TO DISENGAGE AND MOVE TO DEFENSIVE POSITIONS SOUTH OF TF 1-15
0730		53 MD COMMANDER ORDERS 3/23 TO REINFORCE TF 1-95 IN POSITION SOUTH OF TF 1-15. TF 1-13 ORDERED TO MOVE FROM BLOCKING POSITION AT PL220684 TO LINE SOUTH OF TF 1-15
0755		ELEMENTS OF TF 1-15 ARRIVE AT DEFENSIVE POSITIONS AT PL[illegible]31677
0800	440 MRR REACHES PL250658 WITH LITTLE RESISTANCE 80F TD COMMANDER ORDERS ATTEMPTED BREAKTHROUGH TO BRAZOS RIVER AT GODLEY (PL210662)	DIVISION COMMANDER ORDERS 3/53 TO MOVE TF 6-31 FROM PL[illegible]0674 INTO 3/23 SECTOR TO POSITION ON WEST SIDE OF BRAVO/ RIVER
0805	80F TD COMMANDER ORDERS 213 TR TO MOVE FORWARD FROM PL340719 TO REAR OF 440 MRR TO EXPLOIT POSSIBLE PENETRATION	DIVISION COMMANDER ORDERS 1/53 ARTILLERY SUPPORT, FA 2-40 AND FA 1-17 TO INTERDICT 440 MRR ADVANCE IN AVENUES OF APPROACH NEAR PL240658
0810		DIVISION COMMANDER REALLOCATES 5 AIRBORNE TACAIR SORTIES TO SLOW 440 MRR ADVANCE
0820		TF 1-15 OPERATING FROM DEFENSIVE POSITIONS HALTS 212 TR ADVANCE AT PL231677
0830	440 MRR HALTS TEMPORARILY DUE TO AIR STRIKE AND ARTILLERY LAID MINES AT PL241659	
0840		ELEMENTS OF TF 1-95 SET UP DEFENSIVE POSITIONS AT PL230654
0845	FORWARD UNITS OF 213 TR MOVING SOUTHWEST AT PL300679	
0905		TF 1-13 IN POSITION NORTH OF TF 1-95 AT PL230664 TF 6-31 IN POSITION AT PL265649

Fig. 3.2-7 SUBSCENARIO 2 - CONTAINING 80F TD FLANKING ATTEMPT

TIME	RED FORCE ACTIONS	U.S. ACTIONS
0310	281 MRR ENTERS LINE OPPOSITE 1/53 AT PL310624	
0345	ARTILLERY BARRAGE INITIATED BY 15E MD ARTILLERY AGAINST 1/53 SECTOR	
0100		FA 2-73, 1-17, AND 2-40 EXECUTE COUNTERFIRE AGAINST 15E MD ARTILLERY
0130	281 MRR MOVES FROM PL304597 TOWARD PLOWMAN LEADING WEST IN AN ATTEMPT TO GAIN HIGH GROUND NORTH OF CITY, KEEP ANY UNITS FROM BEING SHIFTED NORTHWARD TO ASSIST AGAINST TF 1-58, AND POSSIBLY ATTACK U.S. UNITS TO THE SOUTH	
0435	282 MRR ADVANCES FROM PL329652 NORTHWEST AGAINST SOUTHERN ELEMENTS OF THE 1/53 WITH LIMITED OBJECTIVE OF SUPPORTING 281 MRR THRUST BY FORCING 52 MD COMMANDER TO RETAIN BLOCKING FORCES RATHER THAN RELEASE THEM TO 53 MD	
0515		- RECOGNIZING RAPID ADVANCE OF 281 MRR AND IN ACCORDANCE WITH PREPLANNED OPTION 53 MD COMMANDER ORDERS 1/53 TO MOVE BULK OF TF 1-58 (PL292605) INTO PREPARED DEFENSIVE POSITIONS AT THE INTERSECTION OF HIGHWAY 56 AND HIGHWAY 203
0540	281 MRR ADVANCES 2 KM VS TF 1-58 TO PL288607 REACHING HIGHWAY 56	
0545	281 MRR COMMANDER ATTEMPTS TO ADVANCE RAPIDLY TO HIGH GROUND NORTH OF PLOWMAN BY MOVING ARMOR TO SOUTHWEST DOWN HIGHWAY 56 TO BRAZOS RIVER	
0550		- 53 MD COMMANDER REQUESTS 52 MD ARTILLERY SUPPORT IN 1/53 SECTOR VS 281 MRR FORWARD UNITS
0600		- FA 2-71 AND FA 2-72 BEGIN INTERDICTION FIRE ALONG HIGHWAY 56 IN AREA PL285605
0605		- ELEMENTS OF TF 1-58 OCCUPY PREPARED DEFENSE POSITIONS NEAR INTERSECTION OF HIGHWAYS 56 AND 203 (PL270660)
0610		- 53 MD COMMANDER ORDERS 1/53 TO MOVE BLOCKING FORCES SOUTH TO HIGH GROUND WEST OF BRAZOS RIVER. 1/53 ORDERS TF 2-37 FROM BLOCKING POSITION PL241606 TO POSITION WEST OF PLOWMAN
0612		- UNITS OF 502 ENGINEERS ORDERED BY 53 MD TO INSURE REAR ACCESS ROUTES FOR TF 1-58 ACROSS RIVER AND PROVIDE FOR DEMOLITION OF ALL OTHER ROUTES
0615	282 MRR (PL316566) MAKES LITTLE HEADWAY VS TF 1-84 EAST OF PLOWMAN 282 MRR DOES NOT COMMIT RESERVE BATTALIONS	
0620	278 TR(PL378559) ORDERED TO MOVE NORTHWEST TO BE IN POSITION TO EXPLOIT POSSIBLE BREAKTHROUGH BY 281 MRR	
0630	281 MRR HALTED AT PL275607 BY TF 1-58 AND ARTILLERY FIRE	
0642		- TF 1-85 (PL175579) ORDERED FORWARD TO BLOCKING POSITIONS BEHIND TF 2-37
0715		- TF 2-37 OCCUPIES HIGH GROUND ON WEST BANK OF RIVER OPPOSITE PLOWMAN AT PL260561
0740	278 TR REACHES ASSIGNED DESTINATION EAST OF PLOWMAN AT PL328589	
0752		- ELEMENTS OF TF 1-85 ESTABLISH BLOCKING POSITIONS NEAR PL230594

Fig. 3.2-8 SUBSCENARIO 2 - CONTINUED, 15E MD ADVANCE

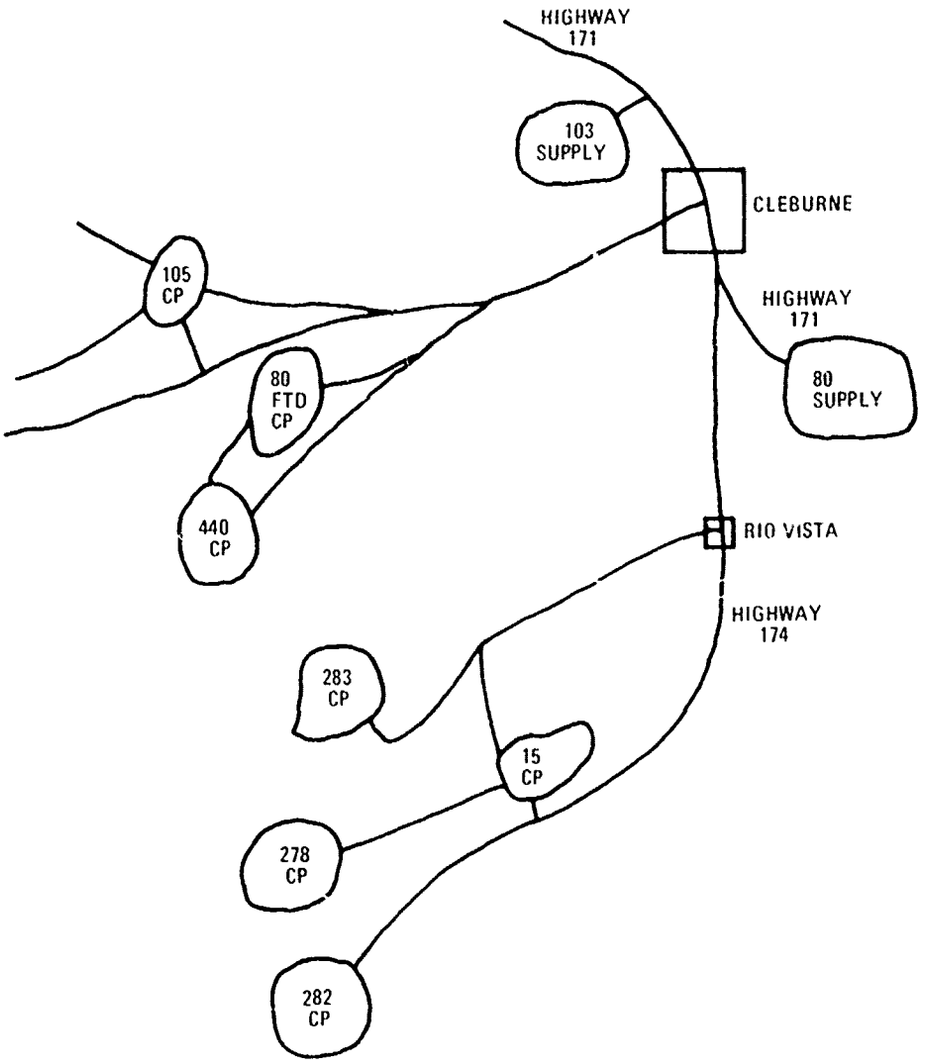


Figure 3.2-9. SUBSCENARIO 4 ROAD SEGMENTS.

TIME	RED FORCES ACTION	U.S. ACTION
0310	206F TD Opcon'd to 16 TA leaves assembly area (PL940864) of 12 TA toward projected exploitation line in 15F MD sector with objective to begin attack at 1200 hours, cross Brazos River south of Plowman and moving northwest of White Bluff to envelope U.S. 23 AD and 53 MD divisions. 206F TD exercises radio silence.	
0325	SA-6 Regiment arrives at 102 TD assembly area (PL815714).	
0330	3 battalions of 1st TA Artillery leave PL815654 to support 206F TD in 15F MD area.	
0335	1 FROG battalion leaves PL815654 to support 206F TD in 80F TD area.	
0405	Division Supply Point for 102 TD established at PL650834.	
0410	3 battalions of 102 TD Artillery leaves assembly area PL815714 to support 102 TD in 101 TD area.	
0415	Division Supply Point for 206F TD established PL620594.	
0417	1 FROG battalion leaves PL815714 to support 102 TD in 101 TD area.	
0440		17th AAC FARRPS established by Corps in 23 AD area at PL040584 and NL970804.
0500	SA-6 Regiment moves forward from rear area PL815714 to support 102 TD in 101 TD area.	
0533	102 TD leaves assembly area (PL815714) for rear of 80F TD to pass through 101 TD and cross the Brazos River in 1/23 sector, intersect Highway 377 and head southwest of White Bluff to envelope 23 AD and 53 MD.	

FIGURE 3.2-10. SUBSCENARIO 5 - RECOGNITION OF 2ND ECHELON ACTIVITIES

TIME	RED FORCES ACTION	U.S. ACTION
0554	FROG battalion, attached to 206F TD, in position at PL530564.	
0559	3 batteries of SA-6 AD units move forward from PL530774 to support 206F TD operations.	
0604	206F TD Artillery support in place in area of PL410654 northwest of 15F MD Artillery positions.	
0609		ASACAC provides 53 MD TOC with report on radio silence by 206F TD, location of division presently uncertain.
0630	Lead elements of 102 TD at PL550734.	
0637	102 TD Artillery in place in the area of PL350734 southwest of 101 TD positions.	
0652	102 TD FROG battalion in position at PL440794.	
0700	GSP ferry material arrives at Regimental Supply Depot of 11 MRR/206F TD at PL460604	
0710	206F TD enters 15F MD rear on Highway 67 PL575561, significant increase in communications traffic of 15F MD in coordinating movement.	
0735	102 TD enters 101 TD rear on Highway 171 at PL519319, significant increase in communications traffic 101 TD in coordinating movement.	
0759	102 TD's SA-6 Regiment in place at PL380814.	
0805		I Corps commander orders 53 MD to shift 2nd Echelon Battalions north to 23 AD boundary to provide better location for rapid movement to 1/23 sector. 53 MD orders TF2-44 (PL030774) and TF3-36 (PL040744) northward.

FIGURE 3.2-10. SUBSCENARIO 5 - RECOGNITION OF 2ND ECHELON ACTIVITIES (CONT'D)

These subscenarios, which comprise the DIVRAS experimental scenario, were selected and developed because they were considered as an important and realistic set of tactical operations for DIVRAS to be demonstrated and tested against.

3.3 SCENARIO INTERACTION ANALYSIS

The DIVRAS Experimentation Scenario provided the Military Grid Reference Coordinates for locating Friendly and Enemy Units down to the battalion levels as well as their movements and activities at specific times during the scenario.

In order to attain a viable target acquisition model, these enemy units had to be equipped, the friendly units provided a reasonable set of sensors, and finally, rules defined so that the two sides (friendly and enemy) could interact. The following subparagraphs discuss the target and sensor models used and the means used to permit them to interact realistically while at the same time conforming to the scenarios defined.

3.3.1 Enemy TOE and Activity Models (Ref. FM30-40, FM30-102)

Figure 3.3-1 lists the enemy units involved in the DIVRAS Experimentation Scenarios. In order to develop a target model, each of these units had to be populated with the appropriate kinds and numbers of equipment. This was provided, primarily, by the referenced documents. The equipment for each unit was next categorized as Movers (includes trucks, tanks, APC's, etc.), Shooters and Emitters (radios and radars). The Moving Targets were further configured into logical groups. Figure 3.3-2 depicts an arrangement used for determining the grouping of moving targets in the battalions of a nominal Tank Regiment. Figure 3.3-3 shows the

	UNIT TYPE	IDENTIFYING NUMBER OF UNIT
1	Tank Regiment - Two Lead Battalions	64, 65, 33F, 212
2	Tank Regiment - 2nd Echelon Battalion	64, 65, 212
3	Tank Regiment - CP	64, 65, 33F, 212, 220, 213, 278
4	Tank Regiment - Two Lead and 2nd Echelon Battalion	220, 213, 278
5	Motorized Rifle Regiment - Two Lead Battalions	204, 440, 281, 282
6	Motorized Rifle Regiment - 2nd Echelon Battalion	204, 440, 281, 282
7	Motorized Rifle Regiment - CP	204, 440, 281, 282, 283
8	Motorized Rifle Regiment - Two Lead and 2nd Echelon Battalion	283
9	Tank Division - Without Artillery Regiment, SA-6 Regiment, FROG battalion and Motorized Transport Battalion	102, 206
10	Tank Division - Artillery Regiment	102, 206
11	Tank Division - SA-6 Regiment	102, 206
12	Tank Division - FROG Battalion	102, 206
13	Tank Division - CP	103
14	Tank Division - Artillery Battery	80F, 101
15	Motorized Rifle Division - CP (Without Artillery)	15F
16	Motorized Rifle Division - Artillery Battery	15F
17	Tank Division - Division Supply Point	102, 206
18	Motorized Rifle Regiment - Regiment Supply Point	11
19	Tank Regiment - Regiment Supply Point	66
20	Tank Division - Assembly Point	102
21	Army Group Artillery Assembly Point	
22	Tank Division - CP Without Artillery Regiment	80F

FIGURE 3.3-1. DIVRAS EXPERIMENTATION SCENARIOS - ENEMY UNITS

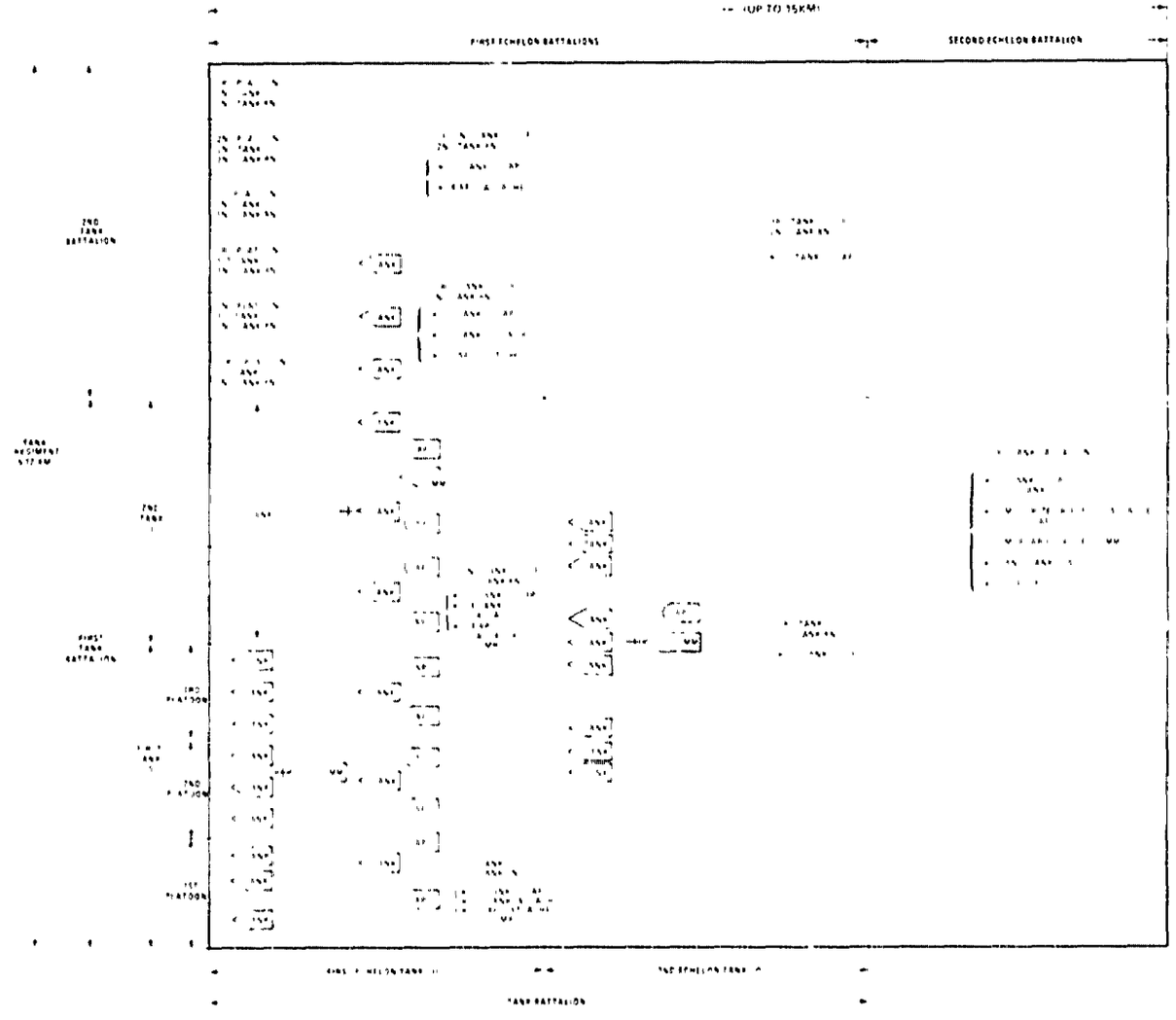


Figure 3.3-2. NOMINAL TANK REGIMENT.

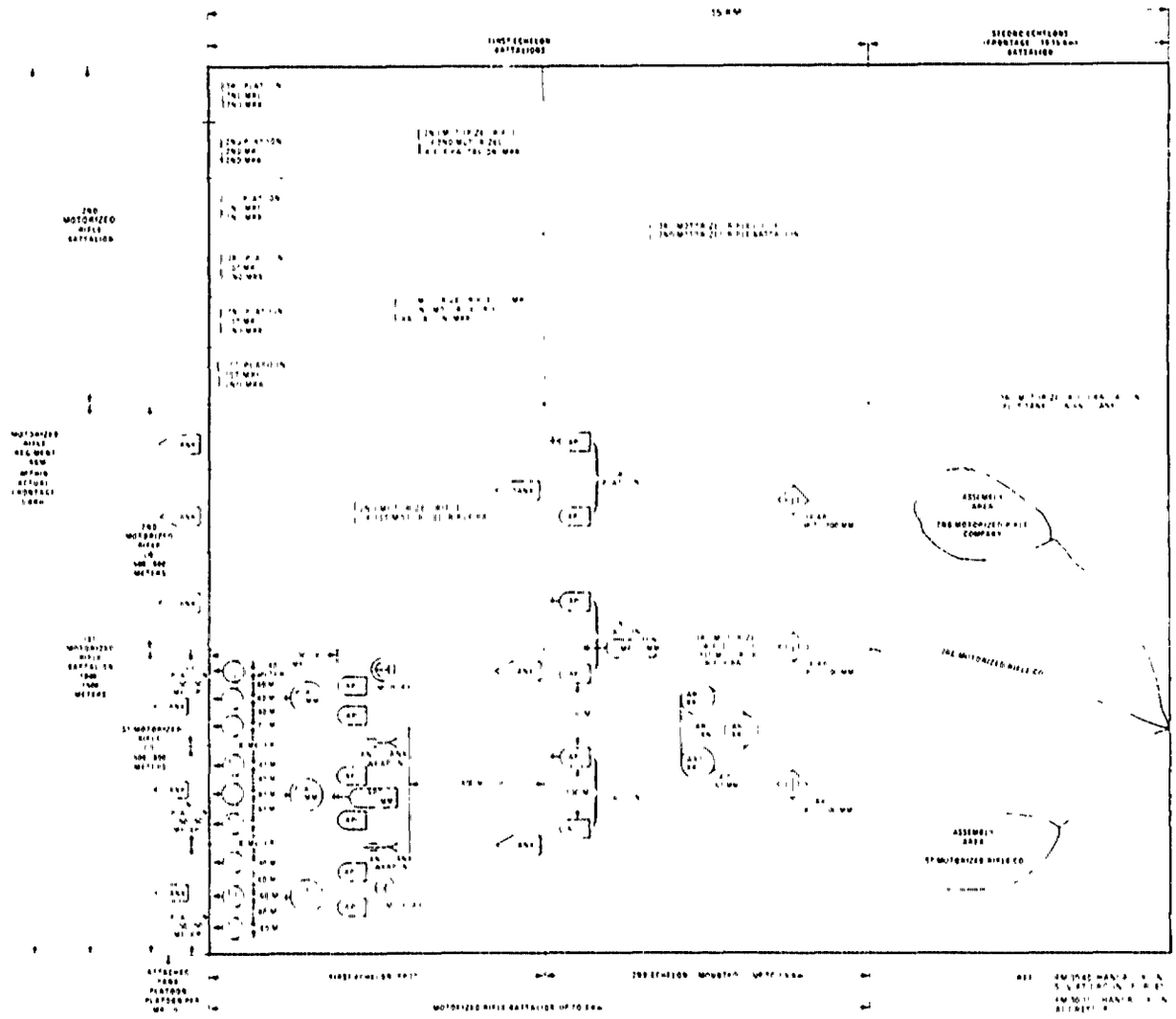


Figure 3.3-3. NOMINAL MOTORIZED RIFLE REGIMENT.

arrangement used for a nominal Motorized Rifle Regiment. From Figure 3.3-2, for example, the following grouping was made for the moving targets in the lead battalions of a Tank Regiment:

4	Groups of 10 tanks per group
3	Groups of 3 tanks per group
1	Group of 6 APC's per group
1	Group of 4 APC's and 1 tank per group
2	Groups of 9 tanks per group
2	Groups of 1 tank and 1 APC per group

13 = Number of Moving Target Groups in Tank Regiment - Two Lead Battalions

Appendix A contains a detailed listing of all the Movers, Shooters and Emitters for each of the units listed in Figure 3.3-1. Figure 3.3-4 summarizes the target listing contained in the Appendix A. As a point of clarification, it should be noted that Figure 3.3-4 indicates that the two lead battalions of the 64 TR, 65 TR, 33FTR and 212 TR each has 13 moving target groups for a total of 4 x 13 = 52 moving target groups. However, the 13 moving target groups are composed in the manner indicated in Appendix A. It is, of course, unrealistic to think that actual units are so consistently equipped and configured. However, this approach does not detract, in any way, from the results of this study.

The next step was to actually populate each specific unit with this generalized set of targets (see Appendix A) and integrate the result with the scenario time line. Figure 3.3-5 is an example of how this was done. The figure shows that the Lead Battalion of the 65 Tank Regiment has no radars, 84 radios, 20 shooters, and no moving targets between 0330 and 0600 scenario time. At 0600, this unit starts to move and the 13 Moving Target Groups continue to move through 0900 scenario time. Referring to Figure 3.3-6, the coordinates are found to be PL200764 between 0330 and

UNIT TYPE	IDENTIFYING NUMBER OF UNIT	TOTAL NUMBER OF MOVING & SHOOTING TARGETS PER UNIT	NUMBER OF MOVING TARGET GROUPS PER UNIT	NUMBER OF SHOOTING TARGETS PER UNIT	NO. OF EMITTERS PER UNIT	
					RADIOS	RADARS
Tank Regiment - Two Lead Battalions	64, 65, 33F, 212	33	13	20	84	-
Tank Regiment - 2nd Echelon Battalion	64, 65, 212	18	7	11	42	-
Tank Regiment - CP	64, 65, 33F, 212, 220, 213, 278	30	18	12	80	-
Tank Regiment - Two Lead & 2nd Echelon Battalion	220, 213, 278	51	20	31	126	-
Motorized Rifle Regiment - Two Lead Battalions	204, 440, 281, 202	32	14	18	124	-
Motorized Rifle Regiment - 2nd Echelon Battalion	204, 440, 281, 282	21	12	9	62	-
Motorized Rifle Regiment - CP	204, 440, 201, 282, 283	23	15	8	95	-
Motorized Rifle Regiment - Two Lead & 2nd Echelon Battalion	283	53	26	27	186	-
Tank Division - Without Artillery Regiment, SA-6 Regiment, FROG Bn, & Motorized Transport Bn	102, 206	139	53	81	1332	-
Tank Division - Artillery Regiment	102, 206	57	3	54	93	7
Tank Division - SA-6 Regiment	102, 206	30	10	20	45	2
Tank Division - FROG Battalion	102, 206	7	3	4	30	2
Tank Division - CP	103	183	103	80	462	27
Tank Division - Artillery Battery	80F, 101	7	1	6	11	1
Motorized Rifle Division - CP (Without Artillery)	15F	110	84	26	413	11
Motorized Rifle Division - Artillery Battery	15F	7	1	6	11	1
Tank Division - Division Supply Point*	102, 206	7	-	-	-	-
Motorized Rifle Regiment - Regiment Supply Point**	11	14	9	-	-	-
Tank Regiment - Regiment Supply Point**	66	14	9	-	-	-
Tank Division - Assembly Point	102	54	54	-	50	-
Army Group Artillery Assembly Point		102	12	90	75	8
Tank Division - CP Without Artillery Regiment	80F	120	94	26	369	20

*Targets such as depots, artillery and small arms ammo, POL, and Support Dumps, etc.
**Deals with road convoys, plus POL, ammo and Rations Dumps, Motor Vehicle, tanks and Weapons Repair.

FIGURE 3.3-4. SUMMARY TARGET LIST

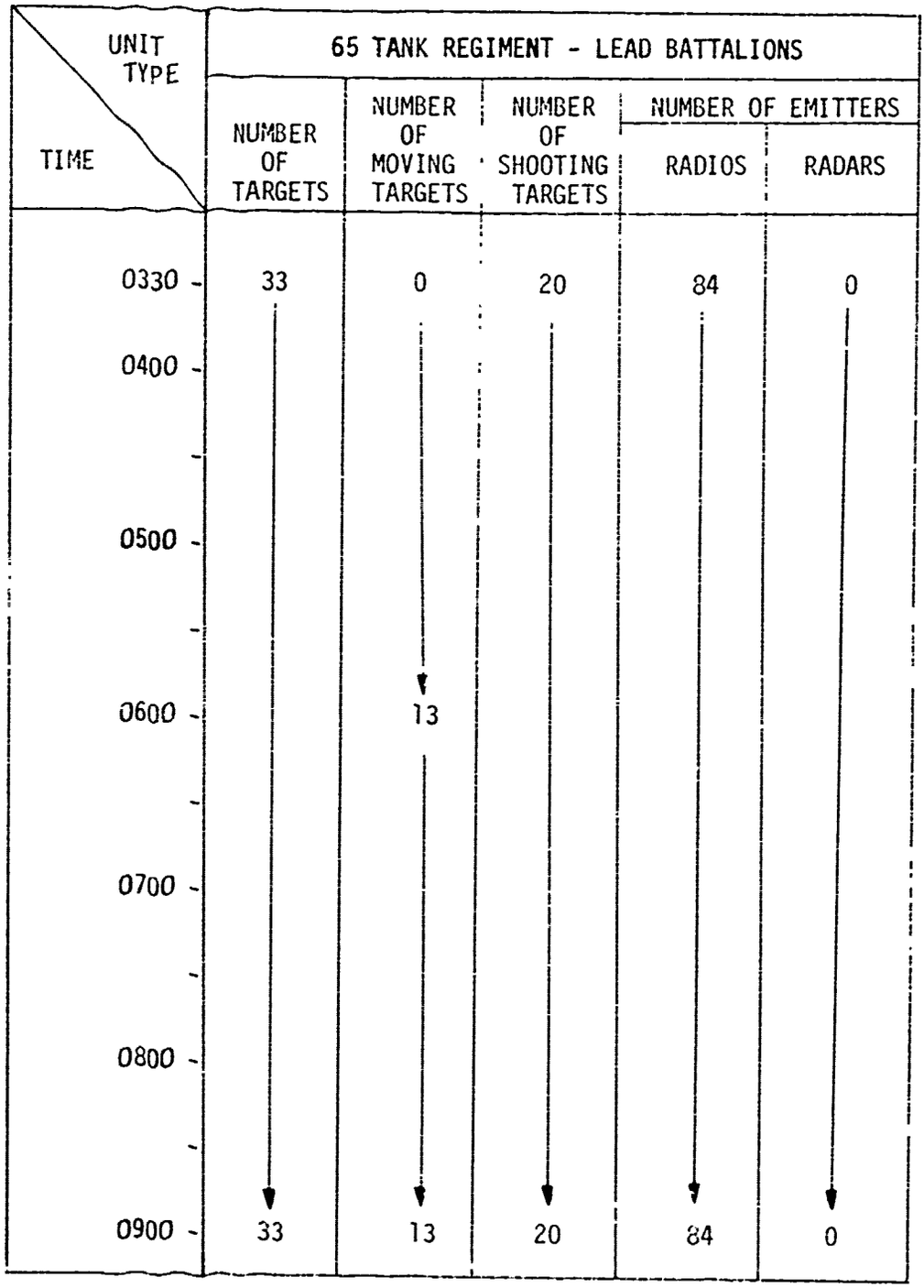


FIGURE 3.3-5. TARGET TIME/MOVEMENT HISTORY

UNITS	64TR Lead Bns	64TR 2d ECH	64TR CP	65TR LD Bns	65TR 2d ECH	65TR CP	204MRP Lead Bns	204MRP 2d ECH	204MRP CP	33 FTR Lead Bns	33 FTR CP	103 TD CP	80 FTD ARTY UNITS	101 TD ARTY UNITS
Time														
----	PL230744 →		→	PL200754	PL215759	PL215759	PL230724	PL215724	PL215729	PL255739	→	PL315759	PL410734 PL415714 PL400694 PL400694 PL430699 PL390734 PL395714	PL490829 PL420829 PL420814 PL375834 PL410804 PL325804 PL380809
0400	PL230744 →													
0500	PL210734 →													
----	PL140731													
2[illegible]	PL140734	PL210734		PL200754	PL215754	PL215759	PL230724	PL215724	PL215729					

2[illegible]			PL23074[illegible]					PL205724		PL255739				

2[illegible]					PL210767									
----			PL205734		PL190734					PL210734				
0900	PL130734	PL130734		PL190754	PL190734	PL215759	PL1[illegible]	PL[illegible]714	PL[illegible]714		PL255739	PL315759	Same as Above	Same as Above

FIGURE 3.3-6 ENEMY UNIT MGR LOCATIONS - SUBSCENARIO 1

0600 and from 0600 to 0900 the unit moves from PL200764 to PL185754. By referring to Appendix A, under Tank Regiment - Lead Battalion, it is possible to determine the specific shooting and moving targets. Appendix B contains the complete set of the target movement histories and their military grid reference locations.

3.3.2 Friendly Surveillance Model

The proposed Technical Interface Concept (TIC) for a Target Acquisition Control System (Draft) is the baseline used for identifying the friendly surveillance systems. The sensors considered as organic division assets for this study are as follows:

1. SOTAS - Heliborne Moving Target Indicator Radar
2. Teampack - Ground ELINT System
3. Trailblazer - Ground COMINT System
4. AN/TPQ-37 - Artillery Locating Radar
5. FAALS - Field Artillery Acoustic Locating System
6. AN/TPS-58A - Ground Surveillance Radar
7. AN/PPS-5 - Ground Surveillance Radar
8. AN/PPS-15 - Ground Surveillance Radar

In addition, the following Corps assets were used to contribute to the Division target acquisition task:

1. OV-1D - Airborne PHOTINT System
2. Quick Look - Airborne ELINT System
3. Guardrail - Airborne COMINT System

The SOTAS and GSR systems only detect moving targets within their effective range. The AN/TPQ-37 and FAALS detect either the shell or the sound when a round is fired by an artillery piece. They, therefore, only

locate the gun of a battery when it fires. In addition, the ground rule was used that the unit had to be fixed, i.e., not moving in order to fire. The OV-1D which is a Mohawk aircraft, collects photography, detects fixed and moving targets, but can only collect during daylight hours and must return to an airfield for the film to be processed and interpreted. The COMINT systems detect only radios and the ELINT systems only radars (see Fig. 3.3-7) when actually emitting. Further, the radars only emit, for this study, when the unit to which they are attached is fixed (not moving).

A mathematical model was used to direct these friendly surveillance sensor systems against the enemy target model and generate target messages. The model used is as follows:

$$P = P_D \times P_{MN} \tag{1}$$

where P = the probable number of target reports per hour from one of the sensor systems

P_D = the sensor probability of detection

P_{MN} = the maximum number of potential target reports by sensor per hour

The sensor probability of detection is defined as:

$$P_D = P_I \times P_{LOS} \times D \tag{2}$$

or

$$P_D = P_I \times P_{LOS} \times F_1 \times F_2 \times F_3 \tag{3}$$

where, P_I = the idealized or inherent probability of detection of a given sensor. This is essentially determined from sensor specifications.

Enemy Radios	Enemy Radars
R-104M	Straight Flush
R-105/107	Long Track
R-107/108	Pork Trough
R-113/123	Small Yawn
R-114	Eyed Tray
R-118 BM3	Long Trough
R-125	Bread Bin
R-126	Thin Skin
R-401M	Flat Face
R-405(401M/405)	Fire Can
R-403	Fire Control/Director

FIGURE 3.3-7. ENEMY EMITTERS.

P_{LOS} = the probability of a line-of-sight between the target and sensor and is a function of the terrain (e.g., flat or hilly) and altitude of the sensor and/or target

D = degradation factors = $F_1 \times F_2 \times F_3$

F_1 = visibility or attenuation factor due to atmospheric conditions

F_2 = availability or exposure factor, i.e., is the target hidden or partially hidden by foliage as well as aspect angle and illumination effects

F_3 = activity factor, is specific target moving or not; is it producing a signal that is detectable by the sensor

The maximum number of potential target reports by a sensor type per hour (P_{MN}) is given as:

$$P_{MN} = P_M \times N \tag{4}$$

where P_{MN} = the expected number of targets to be sighted per look by a given sensor type

N = the number of looks (updates) per hour

The parameter P_M is scenario driven and produces the scenario/sensor interaction. To determine its value, the scenario and target model must be correlated with sensor capabilities. For example, an enemy unit must be within the effective range of the SOTAS and must be moving at that time to be considered as having potentially detectable targets.

3.3.3 Friendly Unit Reporting Model

The friendly unit reporting model consists of a series of messages that were generated in accordance with timeline sequential narratives of friendly and enemy actions as depicted in the subscenarios supporting the DIVRAS experimental scenario. Two types of messages were generated by the friendly forces, namely; ESDA (Enemy Situation Data) and FSDA (Friendly Situation Data).

ESDA messages contain information relative to enemy actions and their locations as determined by troops in actual contact, forward observers, and intelligence reports from DEWI-OPS (Division Electronic Warfare Intelligence-Operations). The rules for generation of ESDA messages by the maneuver elements were based on reporting significant enemy troop movements, contacts, and identification and strength of attacking forces, including types of weapons and vehicles used. These messages were generated on a time sequenced basis in accordance with the DIVRAS scenario and received by the DTOC within 3 to 15 minutes of actual event time. Analyzed enemy situation data contained in ESDA intelligence messages received from DEWI-OPS was assumed to have been received 1½ to 2 hours after actual event time.

FSDA messages from the lower echelon to the DTOC are used for reporting friendly unit relocations and other pertinent data of interest relative to the reporting unit. Messages are generated as they occur in accordance with the DIVRAS experimentation scenario arriving at the DTOC at actual event time or within, or no more than, 10 minutes thereafter.

Figure 3.3-8 depicts the ESDA/FSDA message flow.

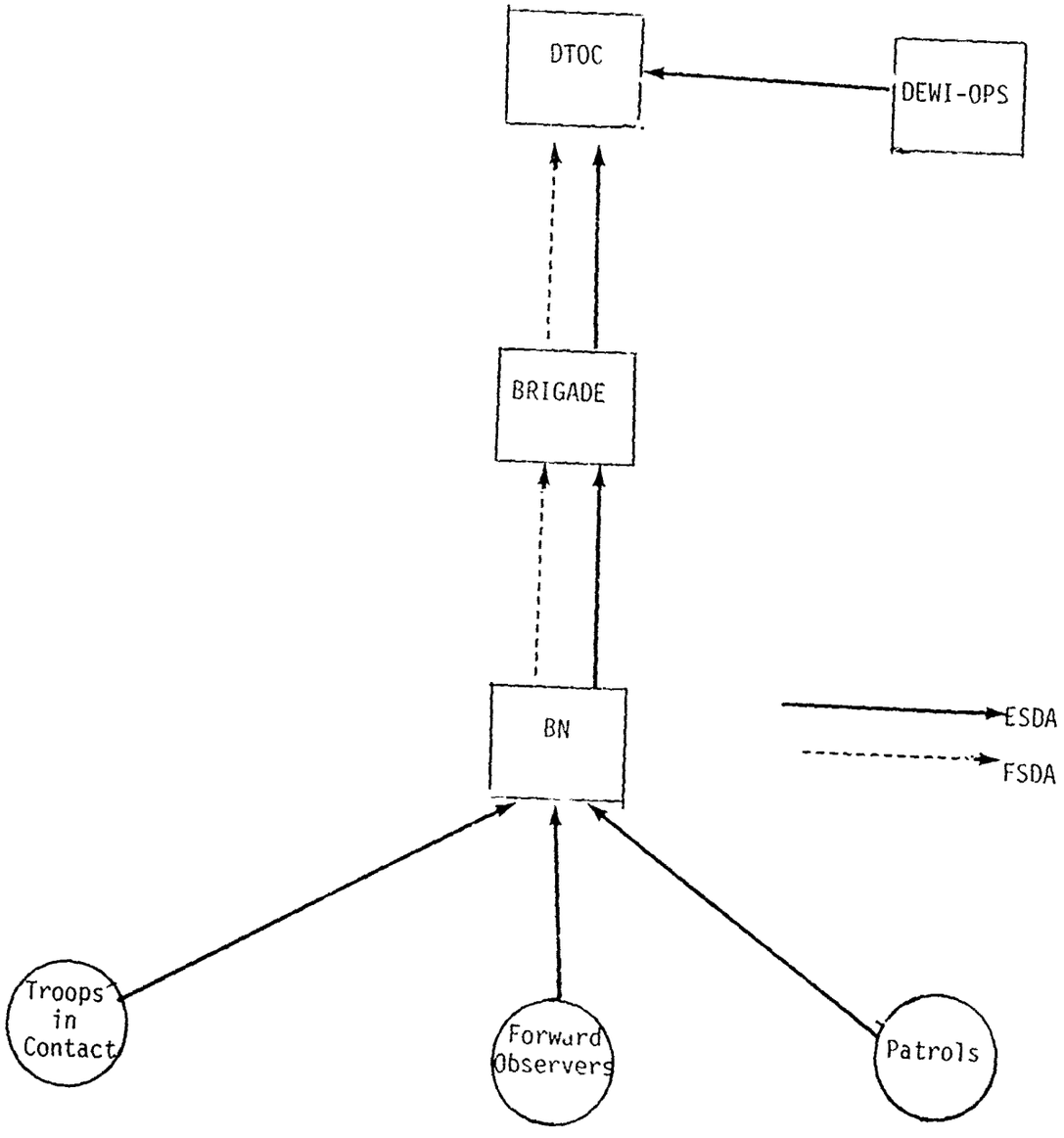


Figure 3.3-8 ESDA and FSDA Message Flow for DIVRAS Scenario

3.3.4 Scenario Sensor Interaction

The target and surveillance models discussed in Sections 3.3.1 and 3.3.2 permit the generation of target reports. The sensor target report is to include: method of detection (sensor used), target location, target type, target unit name or designation, and time of detection. The general procedure used for arriving at target message or report data involves the following steps:

1. Determine those targets which could be detected by each sensor during each hour of the scenario. As mentioned previously, this is done by correlating sensor capability with the target model for each subscenario.

2. List the targets and assign a target number by numbering sequentially. Figure 3.3-9 is an example of such a list for the SOTAS during the time period 0400 to 0500 for Scenarios 1, 2, 3 and 5. Appendix C provides a complete list of the SOTAS sightings by hour, by subscenario for the period from 0400 through 0900 hours. This figure (Fig. 3.3-9) shows that Target Number 14 of Scenario 1, detected by SOTAS, is a moving target group consisting of 11 tanks and 1 APC and that it is attached to the second echelon of the 64th Tank Regiment. The total number of detectable targets for all scenarios is 117 (consisting of 27 for Scenario 1, 46 for Scenario 2, 40 for Scenario 3 and 4 for Scenario 5) for the SOTAS during the 4-5 time period. The number (117) is P_M of Equation 4, Section 3.3.2. Figure 3.3-10 lists the values of P_M for each sensor and scenario time slice.

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME
1	1-4	10 Tanks	Two Lead Battalions, 64 Tank Regiment
1	5-7	3 Tanks	Two Lead Battalions, 64 Tank Regiment
1	8	6 APC's	Two Lead Battalions, 64 Tank Regiment
1	9	4 APC's, 1 Tank	Two Lead Battalions, 64 Tank Regiment
1	10-11	9 Tanks	Two Lead Battalions, 64 Tank Regiment
1	12-13	1 APC, 1 Tank	Two Lead Battalions, 64 Tank Regiment
1	14-16	11 Tanks, 1 APC	2nd Echelon, 64 Tank Regiment
1	17	10 APC's	2nd Echelon, 64 Tank Regiment
1	18-20	7 Tanks	2nd Echelon, 64 Tank Regiment
1	21-23	11 Tanks, 1 APC	2nd Echelon, 65 Tank Regiment
1	24	10 APC's	2nd Echelon, 65 Tank Regiment
1	25-27	7 Tanks	2nd Echelon, 65 Tank Regiment
2	1-4	10 Tanks	Two Lead Battalions, 212 Tank Regiment
2	5-7	3 Tanks	Two Lead Battalions, 212 Tank Regiment
2	8	6 APC's	Two Lead Battalions, 212 Tank Regiment
2	9	4 APC's, 1 Tank	Two Lead Battalions, 212 Tank Regiment
2	10-11	9 Tanks	Two Lead Battalions, 212 Tank Regiment
2	12-13	1 APC, 1 Tank	Two Lead Battalions, 212 Tank Regiment
2	14-16	11 Tanks, 1 APC	2nd Echelon, 212 Tank Regiment
2	17	10 APC's	2nd Echelon, 212 Tank Regiment
2	18-20	7 Trucks	2nd Echelon, 212 Tank Regiment
2	21-24	3 Tanks	Two Lead Battalions, 440 MRR
2	25-28	7 APC's	Two Lead Battalions, 440 MRR
2	29-30	3 Tanks	Two Lead Battalions, 440 MRR
2	31-32	7 APC's	Two Lead Battalions, 440 MRR
2	33-34	2 Self-Propelled Artillery	Two Lead Battalions, 440 MRR
2	35-37	10 APC's	2nd Echelon, 440 MRR
2	38-40	3 Tanks	2nd Echelon, 440 MRR
2	41-46	11 Trucks	2nd Echelon, 440 MRR
3	1-4	3 Tanks	Two Lead Battalions, 281 MRR
3	5-8	7 APC's	Two Lead Battalions, 281 MRR
3	9-10	3 Tanks	Two Lead Battalions, 281 MRR
3	11-12	7 APC's	Two Lead Battalions, 281 MRR
3	13-14	3 Self-Propelled Artillery	Two Lead Battalions, 281 MRR
3	15-17	10 APC's	2nd Echelon, 281 MRR
3	18-20	3 Tanks	2nd Echelon, 281 MRR
3	21-26	11 Trucks	2nd Echelon, 281 MRR
3	27-30	3 Tanks	Two Lead Battalions, 282 MRR
3	31-34	7 APC's	Two Lead Battalions, 282 MRR
3	35-36	3 Tanks	Two Lead Battalions, 282 MRR
3	37-38	7 APC's	Two Lead Battalions, 282 MRR
3	38-40	3 Self-Propelled Artillery	Two Lead Battalions, 282 MRR
5	1-2	20 Trucks to 11 MRR Supply Point	38 Tank Division - Motorized Trans. Bn.
5	3	25 Trucks to 11 MRR Supply Point	206 Tank Division - Motorized Trans. Bn.
5	4	20 Trucks to 66 TP Supply Point	102 Tank Division - Motorized Trans. Bn

FIGURE 3.3-9 SOTAS TARGET LIST BETWEEN [illegible]

SCENARIO TIME	SOTAS EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	SOTAS NUMBER OF TARGET REPORTS (P)	AN/PPS-5 EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	AN/PPS-5 NUMBER OF TARGET REPORTS (P)	AN/PPS-15 EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	AN/PPS-15 NUMBER OF TARGET REPORTS (P)	FAALS EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	FAALS NUMBER OF TARGET REPORTS (P)	AN/TPQ-37 EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	AN/TPQ-37 NUMBER OF TARGET REPORTS (P)	AN/TPS-58A EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	AN/TPS-58A NUMBER OF TARGET REPORTS (P)	TEAMPACK EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	TEAMPACK NUMBER OF TARGET REPORTS (P)	TRAILBLAZER EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	TRAILBLAZER NUMBER OF TARGET REPORTS (P)	CV-1D EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	CV-1D NUMBER OF TARGET REPORTS (P)	GUARDRAIL EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	GUARDRAIL NUMBER OF TARGET REPORTS (P)	QUICK LOOK EXPECTED NUMBER OF TARGETS SIGHTED/LOOK (P_W)	QUICK LOOK NUMBER OF TARGET REPORTS (P)	TOTAL P
4-5	117	34	47	6	34	3	8	14	8	60	113	11	80	11	3290	756	X	X	12	2	2	1	688
5-6	115	33	47	6	34	3	22	45	22	134	100	10	80	10	3290	756	X	X	12	2	2	1	1050
6-7	105	35	137	13	34	9	22	14	22	58	157	16	80	12	3290	756	X	X	195	31	12	5	955
7-8	216	43	86	13	32	9	22	17	22	77	143	14	80	11	3290	756	747	112	233	33	14	5	1096
8-9	255	30	56	22	66	7	22	17	22	69	129	13	80	12	3290	756	X	X	2244	501	33	12	1459
FIVE HOUR TOTALS	833	176	373	70	320	31	96	137	96	458	642	64	400	56	16450	3780	747	112	2667	569	63	25	5448

*Number of Artillery Batteries

**Number of Rounds Detected

FIGURE 3.3-10 SUMMARY OF SENSOR TARGET DETECTIONS AS A FUNCTION OF TIME FOR SCENARIOS 1, 2, 3, 5

3. Calculate the number of target reports by each sensor for each hour of the scenario. This number is defined as "P" in Equation 1, Section 3.3.2. To repeat, P is the product of the sensor probability of detection (P_D), the number of looks (updates) per hour (N), and the maximum number of targets expected to be sighted per look by a given sensor type (P_M). For SOTAS, P_D was 0.08, N was 2.5 and P_M for the 4-5 time period was 117. Therefore, the number of target reports (P) by SOTAS between 0400 and 0500 is 24 (0.08 x 2.5 x 117).

   This means that out of 117 target groups potentially detectable by SOTAS during the 4-5 time period, 24 target reports were made. The distinction is made here between potential targets and target reports. A potentially detectable target only becomes a target report if it is detected. Further, during a given hour there may be more than one target report on a given target. Therefore, the 24 target reports are not necessarily reports on 24 different target groups.

   Figure 3.3-10 also includes the number of target reports (P) for each sensor as a function of scenario time slice.

4. Determine the specific target detected and time of detection. This was done through an APL program which randomly selected the appropriate number of targets (P) out of the total number of potentially detectable targets (P_M) and randomly assigned detection times (within the hour selected) for each detected target.

   Figure 3.3-11 shows the 24 SOTAS target detections and time assignments for the 0400-0500 time period selected from the list of 117 potentially detectable targets for that time period shown in Figure 3.3-10.

	SCENARIO	DETECTION TIME	TARGET NUMBER
(1)	1	0405	9 (4 APC's, 1 Tank - Two Lead Battalions, 64 Tank Regiment)
(2)	1	0410	5 (3 Tanks - Two Lead Battalions, 64 Tank Regiment)
(3)	1	0431	19 (7 Trucks - 2nd Echelon, 64 Tank Regiment)
(4)	1	0439	4 (10 Tanks - Two Lead Battalions, 64 Tank Regiment)
(5)	1	0441	20 (7 Trucks - 2nd Echelon, 64 Tank Regiment)
(6)	1	0455	19 (7 Trucks - 2nd Echelon, 64 Tank Regiment)
(7)	2	0400	28 (7 APC's - Two Lead Battalions, 440 MRR)
(8)	2	0404	25 (7 APC's - Two Lead Battalions, 440 MRR)
(9)	2	0409	6 (3 Tanks - Two Lead Battalions, 212 Tank Regiment)
(10)	2	0411	13 (1 APC, 1 Tank - Two Lead Battalions, 212 Tank Regiment)
(11)	2	0421	21 (3 Tanks - Two Lead Battalions, 440 MRR)
(12)	2	0426	17 (10 APC's - 2nd Echelon, 212 Tank Regiment)
(13)	2	0429	5 (2 Tanks - Two Lead Battalions, 212 Tank Regiment)
(14)	2	0433	19 (7 Trucks - 2nd Echelon, 212 Tank Regiment)
(15)	2	0433	35 (10 APC's - 2nd Echelon, 440 MRR)
(16)	3	0404	40 (3 Self-Propelled Artillery - Two Lead Battalions, 282 MRR)
(17)	3	0410	32 (7 APC's - Two Lead Battalions, 282 MRR)
(18)	3	0413	2 (3 Tanks - Two Lead Battalions, 281 MRR)
(19)	3	0422	32 (7 APC's - Two Lead Battalions, 282 MRR)
(20)	3	0444	26 (11 Trucks - 2nd Echelon, 281 MRR)
(21)	3	0445	21 (11 Trucks - 2nd Echelon, 281 MRR)
(22)	3	0456	26 (11 Trucks - 2nd Echelon, 281 MRR)
(23)	3	0457	2 (3 Tanks - Two Lead Battalions, 281 MRR)
(24)	5	0409	1 (20 Trucks to 11 MRR Supply Point, 206 Tank Division, Motor Transport Bn)

FIGURE 3.3-11 DETECTIONS FOR SOTAS BETWEEN 0400-0500

Appendix C, as stated previously, contains the list of all the potentially detectable targets as a function of scenario and scenario time slice for the SOTAS sensor. It also includes the target number and detection time if the target was detected.

4.0 COMBAT INFORMATION FLOW AND INTEROPERABILITY

The purpose of the DIVRAS program is to specify the functions for handling fires and maneuver information at the DTOC. This analysis, however, goes further to determine the information flow from the source to either the weapons system or the appropriate command node. There are three reasons for performing the analysis.

The first is to determine the most expedient path for information from source to weapon system. This is in keeping with the emphasis on providing real-time targeting data directly to weapons when certain predefined rules of engagement are met.

The second is to better define the rules or parameters which will control the routing of information; bypassing nodes such as the DTOC in some cases. The BSI TACS Technical Interface Concept (March 1976) provided a guideline for required bypasses between various target acquisition, command and control, and weapons systems. This analysis defines the rules under which the bypass will be exercised.

The third reason for this analysis is to define the nature and control of the maneuver and fires information which reaches the DTOC. This is essential to the process of defining the processing functions to be performed within TOS. It is also needed to formulate a representative message scenario to be used in requirements experimentation.

The information flow analysis provides data on the type and volume of information reaching the DTOC from various sources. However, it was necessary to investigate other aspects of system interoperability to fully address the DTOC processing functions. This involved the definition of the two-way exchange between the DTOC and selected tactical systems and nodes utilized in this analysis. This included definition of message types, queries, and data exchange between nodes such as: the DTOC and the ASACAC, the DTOC and SOTAS, the DTOC and TACFIRE, and the DTOC and

Corps. Message formats were also defined which would support the real time data concept at division. However, the question of interoperability did not end at the interfaces but extended into the definition of the DIVRAS processing functions themselves. This was found to be a necessity if the systems are to be interactive.

The sections that follow define the concept for real time information flow; and present the information flow analysis, and the system interoperability which supports the concept.

4.1 CONCEPT FOR REAL TIME INFORMATION FLOW

The concept for real time information flow addresses the need for transmitting data on enemy activity, particularly that derived from sensors, as quickly as possible to the point where it will do the most good. While this is a general, often-stated goal, the concept becomes more specific when based on the following tenets.

1. That battlefield missions can be identified as a series of closed loops (e.g., artillery, electronic warfare, air defense) which contain the information flow wherever possible without DTOC interface.

2. If it is necessary to pass information from one closed loop to another (e.g. EW to Artillery) the command and control nodes should be bypassed in real time wherever possible.

3. The DTOC should provide the rules of engagement which control this real time routing of information.

4. There are many cases where the DTOC does provide significant value added in the real time process by combining information from multiple closed loops to identify a target or maneuver threat.

5. The DTOC processing system should provide the target analyst the capability to selectively monitor the high volume stream of target acquisition data to identify high value targets rapidly.

6. The target acquisition information, if used in real-time, can provide the commander with an excellent picture of the enemy activity, situation and intent.

These guidelines are applied in this analysis both to define information flow and to specify a level of interoperability which will support the concept. Figure 4.1-1 shows the application of the concept to the scenario and sensor data defined in Section 3 of this report. The real-time data concerning every activity is identified in three categories; Movers, Shooters, and Emitters. The numbers indicate the number of detections obtained by the various sensor systems in the six-hour scenario. The concept requires that the DTOC provide to each of the four nodes, a priori, rules of engagement which call for real time target data to be routed between nodes, e.g., SOTAS to TACFIRE when certain target thresholds are exceeded. This provides for direct routing. The question that remains is what data, from the more than six thousand detections, is provided to the DTOC. The answer is different for the targeting application than for the maneuver application.

Figure 4.1-2 indicates the targeting data flow for the DTOC, given that direct routing of weapons has already been provided for. For targeting, only target intelligence messages are forwarded to the DTOC. Each message represents the decision by an analyst at the sensor node that there is target intelligence inherent in one or more of the sensor

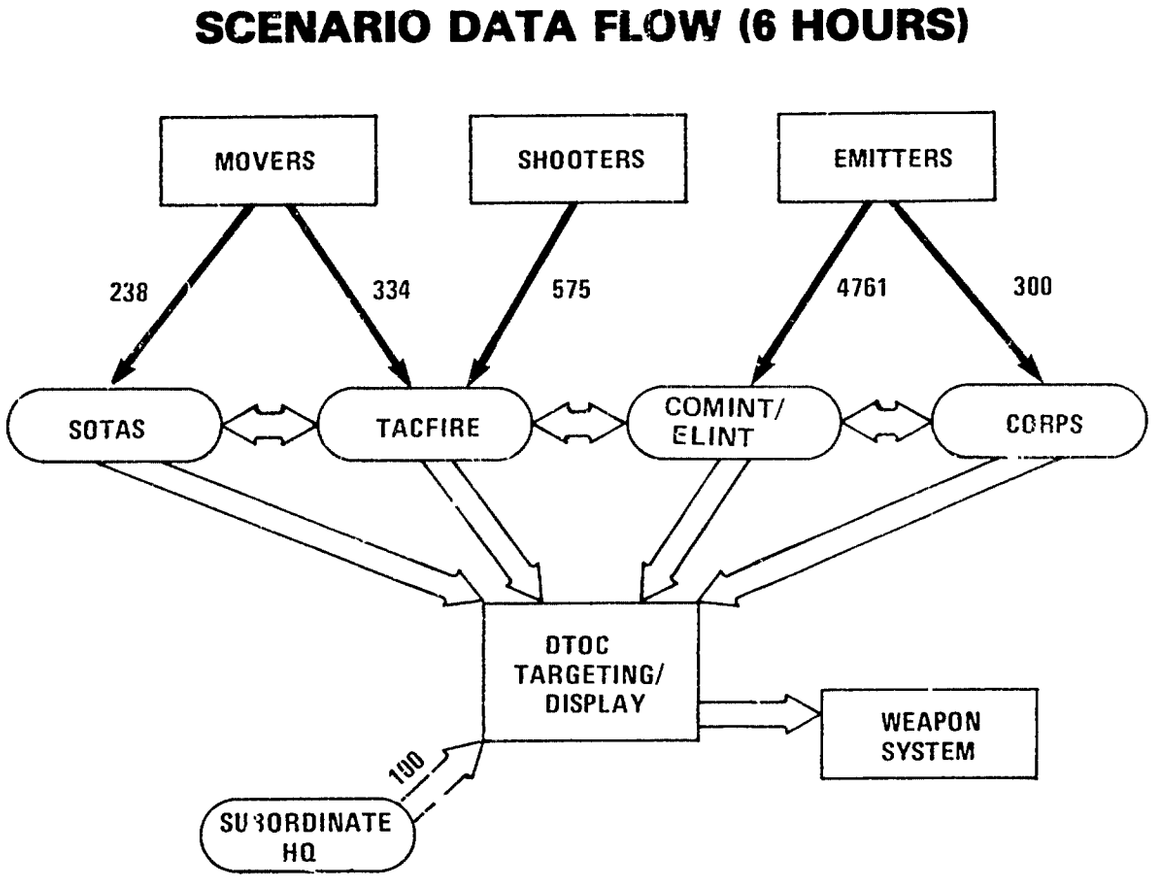


Figure 4.1-1. SCENARIO DATA FLOW.

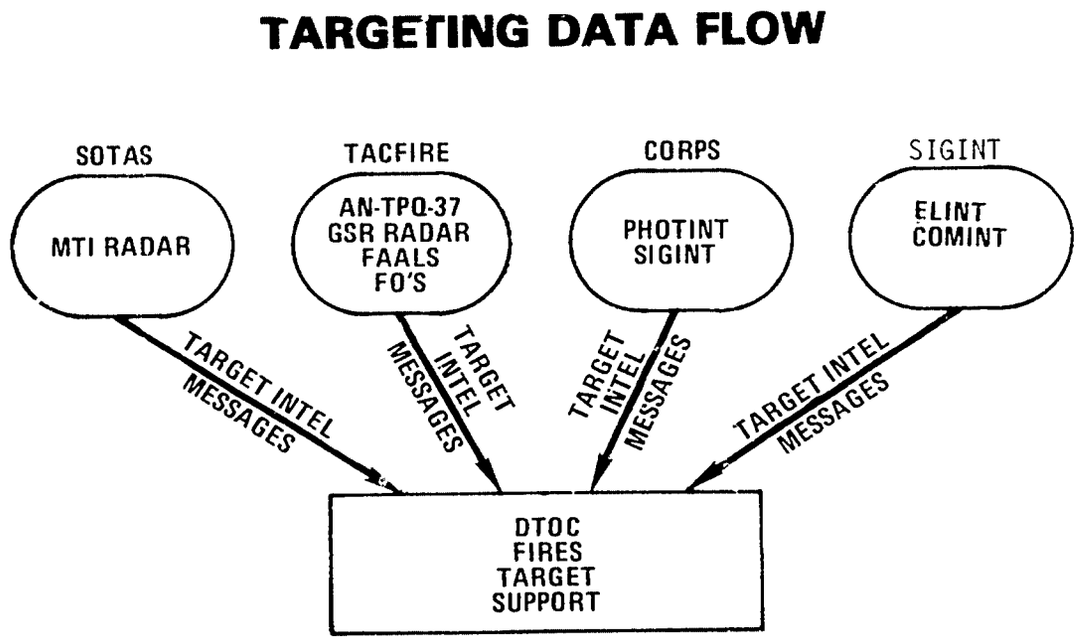


Figure 4.1-2. TARGETING DATA FLOW.

detections. This process varies with each source sensor. SOTAS will pass to the DTOC as target intelligence messages all target tracks identified by the SOTAS operator. The SIGINT processing center will not pass every detection as target intelligence, but will provide a target message when one or more detections indicate an identifiable target. The number of target intelligence messages reaching the DTOC, is therefore, significantly lower than the number of detections. It is these messages that are processed and combined by the fires targeting function to identify viable targets and pass them rapidly to the weapon system.

Section 5.0 of this report provides a complete description of this process.

Figure 4.1-3 indicates the flow of sensor data to support the maneuver function. The basis for this approach is that real-time sensor data presented in mover, shooter, and emitter categories can be effectively utilized by the commander to assess the immediate enemy situation. In this case, all sensor detections are passed to the DTOC in real time, even those that are acted on directly. In this case, there is no analysis of the data as to its target intelligence, but rather, the emphasis is on presentation of the raw data graphically to indicate patterns and clustering. In the example of the scenario data this means that all of the more than 6,000 detections will be presented, at one time or another, on one of the display presentations.

Again, however, each sensor is handled differently. For the emitters all individual emitter locations are passed to the DTOC. In the case of SOTAS only identifiable tracks are passed to the display and not individual radar returns.

Since only location data is transmitted the communications traffic is minimum. To further lower the traffic the various sensors can store and forward this location data to the DTOC periodically, as an effective

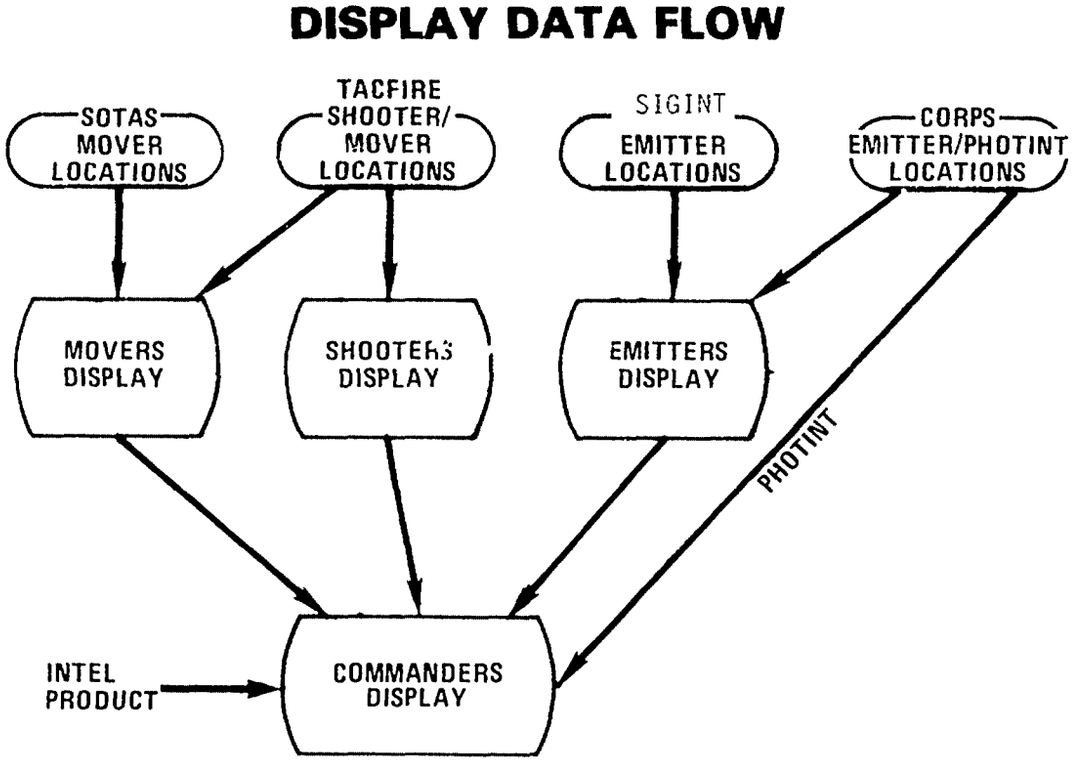


Figure 4.1-3. DISPLAY DATA FLOW.

update mechanism. The net effect is that the very large volume of sensor detection data is utilized by the DTOC in a simple and compact manner to derive significant real time indications of the enemy situation.

More descriptive information on this process is provided in Section 6 of this report.

4.2 COMBAT INFORMATION FLOW ANALYSIS

The purpose of this section is to describe the combat information flow of target intelligence, and maneuver data from the source to the weapons system or appropriate command node. This includes not only the flow but the parameters which will control optional routing or bypassing. The information flow is addressed separately for the passage of target intelligence and for maneuver situation information. In the subsections that follow the flow of combat information is treated in the three categories of "Movers", "Shooters", and "Emitters" in keeping with the concept of real-time Fires and Maneuver support.

All sources that predominantly provide information on enemy movers are addressed in Subsection 4.2.1. Those that provide data on enemy artillery are addressed in 4.2.2. Sources of information for enemy emitters are included in Subsection 4.2.3. The special case of PHOTINT information flow is also provided in 4.2.4.

4.2.1 Information Flow - Movers

This subsection addresses the information flow for data derived from the six primary sources of mover data. These are SOTAS, the Ground Surveillance Radar, Forware Observers, Reconnaissance Patrols, Units in Contact, and other Maneuver Units.

Target Data Flow - Movers

Figure 4.2.1 presents the flow of target data associated with enemy movers. The flow starts at the detection source and can be traced to the executing weapon system. The figure indicates data in two categories that which is target acquisition or target intelligence before a decision to fire has been made, and fire mission requests on fire missions after a target has been designated. Primary or normal paths are indicated by solid arrows, while optional or alternate paths are illustrated with dashed arrows. This figure is used in conjunction with Figures 4.2.2a, b, c to define the flow of information for individual sources.

Figure 4.2.2a indicates the Target Information Routing criteria for SOTAS derived movers. The figure indicates not only the type and content of the data but the criteria for utilizing each of the routing options at each node. For example, at the SOTAS Ground Station, there are three routing options for SOTAS Track Data; the DTOC, DIVARTY, or the Direct Support Artillery Battalion. The parameters which determine this routing are defined under routing criteria. The specific parameter values must be provided on a periodic basis by the DTOC.

The flow is continued for each of the optional nodes through the generation of a fire mission by Artillery, TACAIR, or Attack Helos. This table provides not only the flow options but indicates the information on command guidance which must be provided to each of these nodes to effect the proper routing.

Maneuver Data Flow - Movers

Figure 4.2-3 presents the flow of maneuver data from the six sources associated with enemy mover data. In this figure the flow

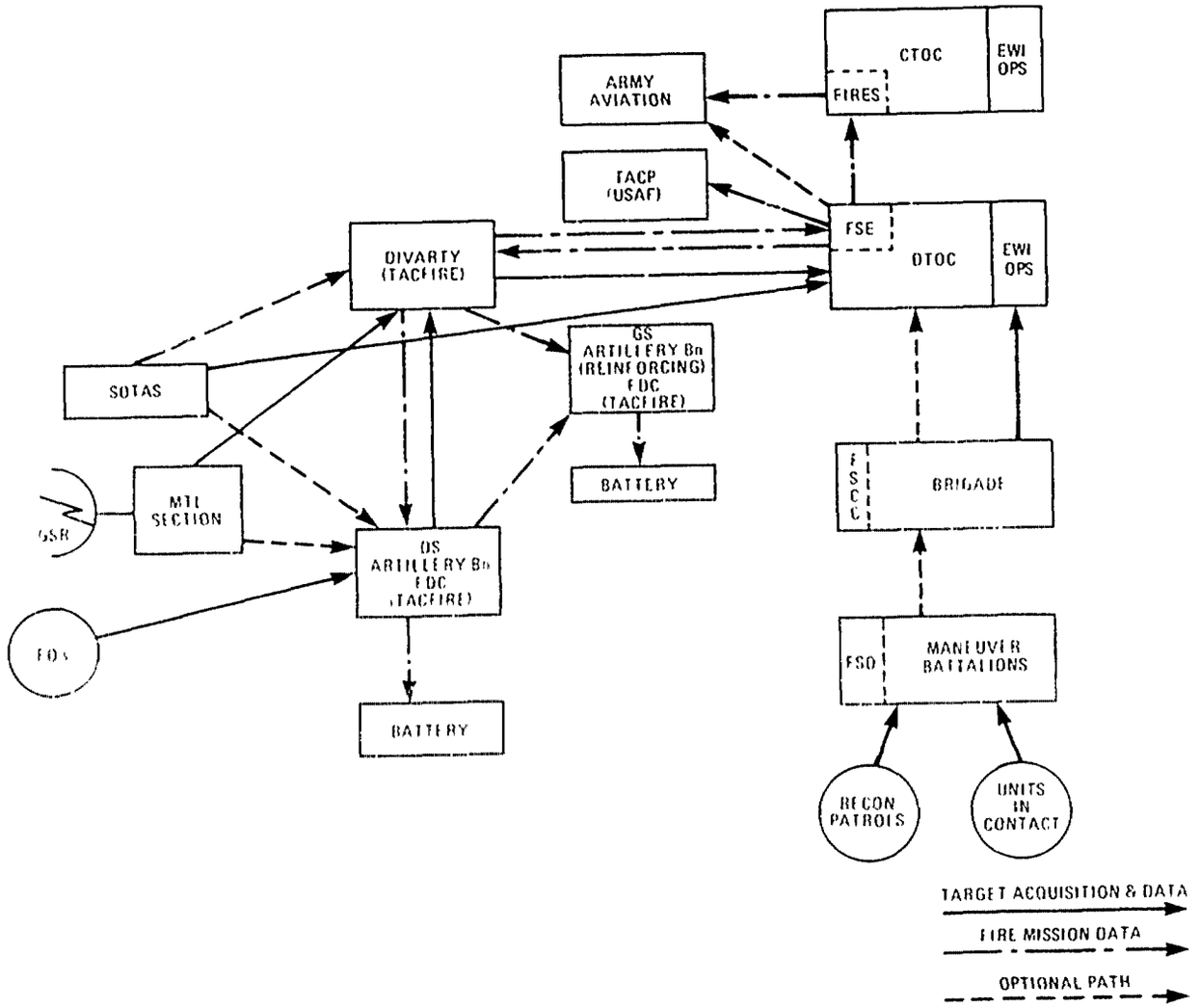


FIGURE 4.2 1. TARGETING INFORMATION FLOW - MOVERS

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
SOTAS Ground Station.	Target Acquisition.	SOTAS Track Data.	DTOC.	- Target Correlation. - Information only.	(1) All SOTAS Track Messages are provided to DTOC.
			DIVARTY (TACFIRE)	- Generate Fire Mission.	(1) Optional routing based upon the following: - # of vehicles exceeds threshold. - Target stationary (inferred from terrain, obstacles, and/or track loss).
			Battalion FDC(TACFIRE)	- Generate Fire Mission.	(1) Optional routing based upon the following: - Preassigned target track from DIVARTY. - Target stationary (inferred from terrain, obstacles, and/or track loss).
DTOC	Fire Mission Request.	Target Data derived from SOTAS Track or Merged Data.	DIVARTY (TACFIRE)	- Generate Fire Mission.	(1) All Fire Mission Requests which meet the following. - Within range of Division Artillery. - Location Accuracy $\leq \Delta e$ (error). - Target Performance $\leq \Delta t$ (response time). - Target type indicates artillery effective.
			TACP (USAF)	- Generate TACAIR Mission.	(1) All Fire Mission Requests which meet the following. - Cannot be engaged through artillery. - Location is within a TACAIR Strike Area. - Target is air observable.
			Corps (AVN) Helo Strike.	- Generate Attack Helo Mission.	(1) All Fire Mission Requests which meet the following: - Cannot be engaged through artillery. - Location is within a Helo Strike Area. - Target is air observable. - Target type indicates Helo strike effective.
			Army Aviation Battalion.	- Generate Attack Helo Mission.	(1) Optional routing based upon the following: - Attack Helo Mission as defined above. - Attack Helo Assets have been upcommed to Division.
DIVARTY (TACFIRE)	Target Acquisition.	SOTAS Track Data merged with other Target Data.	DTOC	- Target Correlation - Information only.	(1) All merged (at TACFIRE) SOTAS Track Messages are provided to the DTOC.
	Fire Mission Request.	Target Data derived from SOTAS Track or Merged Data.	DTOC	- Generate TACAIR or Helo Mission Request.	(1) All Fire Mission Requests which cannot be handled by artillery.
	Fire Mission Request.	Target Data derived from SOTAS Track or Merged Data.	DS Battalion FDC (TACFIRE)	- Technical Coordination and Fire Command Generation	(1) All Fire Missions that are within the resource capabilities and fires priorities of the DS Battalion.
			GS Battalion FDC (TACFIRE)	- Technical Coordination and Fire Command Generation.	(1) All Fire Missions that are not provided to DS Battalions.
DS Battalion FDC (TACFIRE)	Fire Mission.	Fire Command Data to battery based on SOTAS Track.	Artillery Battery (TACFIRE)	- Artillery Fire.	(1) All Fire Missions that are within the resource capabilities and fires priorities of subordinate batteries.

FIGURE 4.2-2a. TARGETING INFORMATION ROUTING - SOTAS.

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTIONS	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
Moving Target Locator Section (GSR)	Target Acquisition	Moving Target Detection or Track Data	DIVARTY (TACFIRE)	- Target Intelligence - Information Only	(1) All GSR Moving Target Detections or Tracks are provided to DIVARTY
			DS Battalion FDC	- Generate Fire Mission	(2) Optional Routing Based Upon the Following: - Preassigned area or target track from DIVARTY - Target Stationary (Inferred from terrain, obstacles, or radar data
DIVARTY (TACFIRE)	Target Acquisiton	Moving Target Detection Track or Merged Data	DTOC	- Target Correlation - Information Only	(1) All GSR Detections for which TACFIRE has merged target data (2) All GSR Detections in target areas which DTOC has indicated as special interest (3) All GSR Detections for which there has been no Fire Mission Request Generated
	Fire Mission Request	Target Data GSR Detection or Merged Data	DTOC	- Generate TACAIR or Helo Mission request	(1) All Fire Mission Requests which can not be handled by artillery
		Target Data Derived from GSR Detection or Merged Data	DS Battalion FDC (TACFIRE)	- Technical Coordination and Fire Command Generation	(1) All Fire Missions that are within the resource capabilities and fires priorities of subordinate batteries
			GS Battelion FDC (TACFIRE)	- Technical Coordination and Fire Command Generation	(1) All Fire Missions that are not provided to DS Battalion
DS Battalion FDC (TACFIRE)	Fire Mission	Fire Command Data to Battery Based on GSR Data	Artillery Battery (TACFIRE)	- Artillery Fire	(1) All Fire Missions that are within resource capabilit and Fires priorities of subordinate battery
DTOC	Fire Mission Request	Target Data derived from GSR Track and merged data	DIVARTY (TACFIRE)	- Generate Fire Mission	(1) All Fire Mission Requests which meet the following: - Within range of Division Artillery - Location Accuracy $< \Delta e$ (error) - Target Permanance $< \Delta t$ (response tim - Target type indicates artillery effective
		Target Data derived from GSR Track or merged data	TACP (USAF)	- Generate TACAIR Mission	(1) All Fire Mission Request which meet the following: - Cannot be engaged through artillery - Location is within a TACAIR Strike Area - Target is air observeable
			Corps (AVN) Helo Strike	- Generate Attack Helo Mission	(1) All Fire Mission Request which meet the following: - Cannot be engaged through artillery - Location is within a Helo Strike Area - Target is air observeable - Target Type indicates Helo Strike effective
			Army Aviation Battalion	- Generate Attack Helo Mission	(1) Optional Routing Based upon the following: - Attack Helo Mission As Defined Above - Attack Helo Assets have been Opconned to Division

Fig. 4.2-2b TARGETING INFORMATION ROUTING - GSR

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
Forward Observer	Target Acquisition	Mover Observation	DS Battalion FDC (TACFIRE)	- Generate Fire Mission - Target Intelligence	(1) All Forward Observer Mover Observations are provided to DS Batallion FDC
DS Battalion FDC	Target Acquistion	Mover Observation	DIVARTY (TACFIRE)	- Generate Fire Mission - Target Intelligence	(1) All Mover Observations for which no Fire Mission has been generated (2) All Mover observations in target areas which DIVARTY has indicated as special interest
	Fire Mission	Target Data Derived from Mover Observation	Artillery Battery	- Artillery Fire	(1) All Fire Missions which are within resource capabilities and fires priorities of subordinate batteries
	Fire Mission Request	Target Data Derived from Mover Observation	GS Battalion FDC	- Technical Coordination and Fire Command Generation	(1) All Artillery Fire Missions that are not assigned to DS Battalion Subordinate batteries
DIVARTY (TACFIRE)	Target Acquisition	Moving Observation or Merged Data	DTOC	- Target Correlation - Information Only	(1) All Mover Observations for which TACFIRE has merged target data (2) All Mover Observations in target areas which DTOC has indicated as special interest (3) All Mover Observations for which there has been no Fire Mission Request Generated
	Fire Mission Request	Target Data Mover Observation or Merged Data	DTOC	- Generate TACAIR or Helo Mission Request	(1) All Fire Mission Requests which can not be handled by artillery
		Target Data Derived from Observation or Merged Data	DS Battalion FDC (TACFIRE)	- Technical Coordination and Fire Command Generation	(1) All Fire Missions that are within the resource capabilities and fire priorities of subordinate batteries
			GS Battalion FDC (TACFIRE)	- Technical Coordination and Fire Command Generation	(1) All Fire Missions that are not provided to DS Battalion
DTOC	Fire Mission Request	Target Data derived from Mover Observation and Merged Data	DIVARTY (TACFIRE)	- Generate Fire Mission	(1) All Fire Mission Requests which meet the following: - Within range of Division Artillery - Location Accuracy $< \Delta e$ (error) - Target Permanance $< \Delta t$ (response time) - Target Type indicates artillery effective
		Target Data derived from Mover Observation or Merged Data	TACP (USAF)	- Generate TACAIR Mission	(1) All Fire Mission Requests which meet the following: - Cannot be engaged through artillery - Location is within a TACAIR Strike Area - Target is air observeable
			Corps (AVN) Helo Strike	- Generate Attack Helo Mission	(1) All Fire Mission Requests which meet the following: - Cannot be engaged through artillery - Location is within a Helo Strike Area - Target is air observeable - Target Type indicates Helo strike effective
			Army Aviation Battalion	- Generate Attack Helo Mission	(1) Optional Routing Based upon the following: - Attack Helo Mission As Defined Above - Attack Helo Assets Have Been Opconned to Division

Fig. 4.2-2c TARGET INFORMATION ROUTING FORWARD OBSERVATIONS

MANEUVER INFORMATION FLOW

MOVERS & MANEUVER UNIT DATA

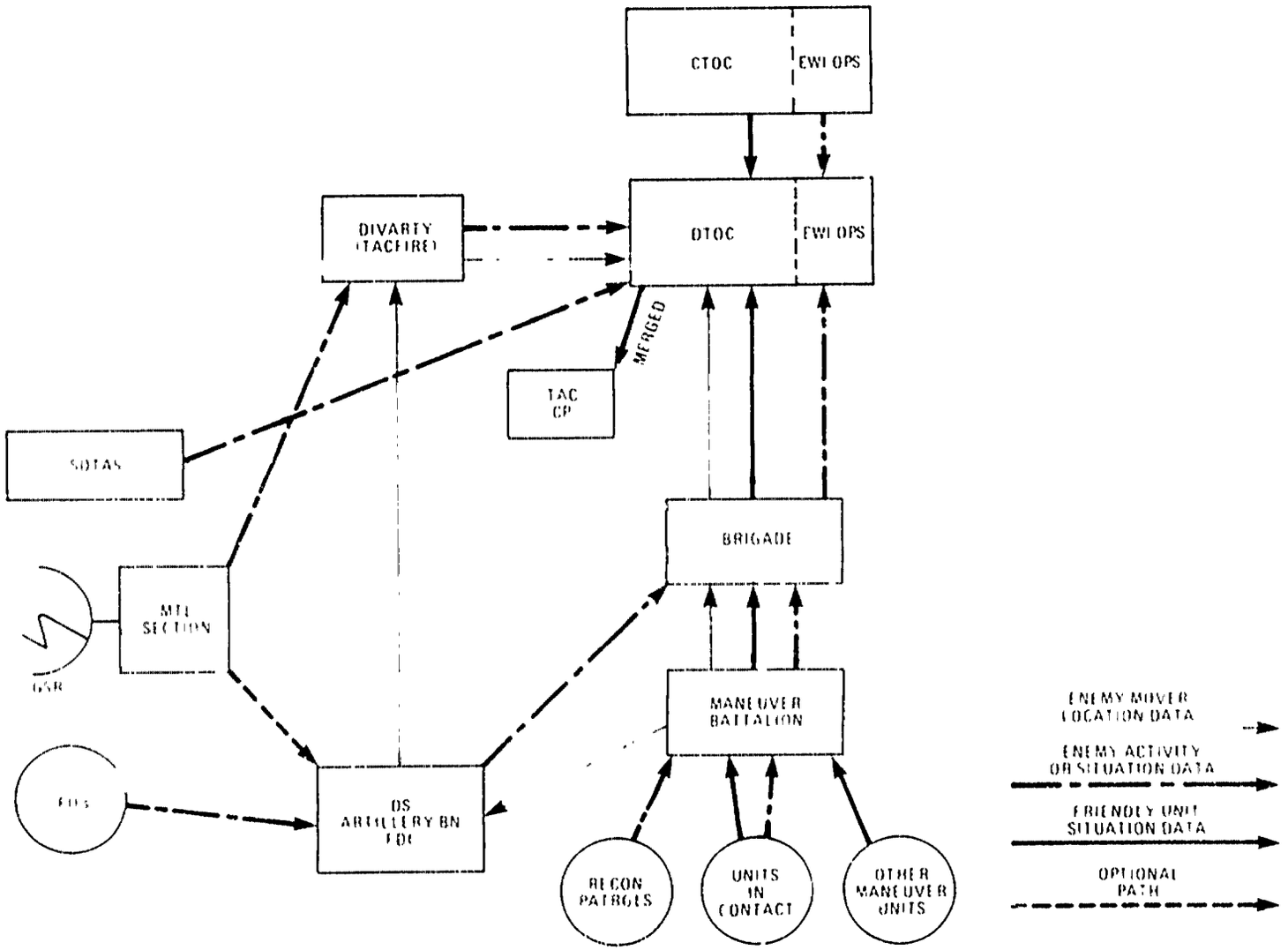


Figure 4.2-3. MANEUVER INFORMATION FLOW - MOVERS.

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OFFICE	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
SOTAS Ground Station	Target Acquisition	SOTAS Track Data Including Mover Locations	DTOC	- Maneuver Display - Enemy Situation	(1) All SOTAS Track Messages are provided to DTOC
Moving Target Locator Section (GSR)	Target Acquisition	Moving Target Detection or Track Data	DIVARTY (TACFIRE)	- Information only	(1) All GSR Moving Target Data provided to DIVARTY
			DS Battalion FDC	- Interface to Brigade	(2) Optional Routing Based Upon the Following: - Preassigned Areas of Interest Designated by Brigade - Impending Near Term Threat to Brigade or Subordinate Battalions
DIVARTY TACFIRE	Target Intelligence	Moving Target Locations	DTOC	- Maneuver Display	(1) All GSR Detections (as Identified by GSR Operator) are passed to DTOC
DS Battalion FDC (TACFIRE)	Target Intelligence	Moving Target Detection or Track Data	Brigade	- Enemy Situation	(1) All Maneuver Information Passed thru DIVARTY TOC to DS Battalion FDC Forwarded thru TACFIRE to Brigade
Forward Observer	Target Intelligence	Observation of Enemy Mover or Units	DS Battalion FDC (TACFIRE)	- Enemy Situation	(1) All Forward Observer Sightings are provided to Battalion FDC
DS Battalion FDC (TACFIRE)	Target Intelligence	Observation of Enemy Mover or Units	Brigade	- Enemy Situation	(1) All Maneuver Data Based Upon the Following: - Preassigned Areas of Interest Designated by Brigade - Impending Near Term Threat to Brigade or Subordinate Battalions
	Target Intelligence	Moving Target Locations	DIVARTY (TACFIRE)	- Interface to DTOC	(1) All FO Moving Target Locations are routed to DIVARTY
(Forward Observer Data) DIVARTY TACFIRE	Target Intelligence (Derived from Forward Observers)	Moving Target Locations	DTOC	- Maneuver Display	(1) All FO Moving Target Locations are Routed to DTOC

Fig. 4.2-4a MANEUVER INFORMATION FLOW - SOTAS, GSR, AND FORWARD OBSERVERS

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
Recon Patrols, Units In Contact	Enemy Activity Data	Observation of Enemy Mover or Units	Maneuver Battalion	- Enemy Situation	(1) All Enemy Activity Data Is Provided to the Maneuver Battalion
Maneuver Battalion	Enemy Activity Data	Observation of Enemy Mover or Units	Brigade	- Enemy Situation	(1) All Mover and Enemy Situation Data, unless data is is provided directly to TACFIRE for Targeting
		Moving Target Locations	DS Bn FDC (TACFIRE)	- Enemy Situation	(1) All Moving Target Locations which are selected for Fire Missions
Brigade	Enemy Activity Data	Observation of Enemy Movers or Units	DEWI-OPS	- Enemy Situation	(1) All Enemy Activity, Data as follows: - Periodic Report of Enemy Situation - High Interest Reports of Enemy Activity effecting maneuver of battalion or above
		Moving Target Locations	DIOC	- Maneuver Display	(1) All Moving Target Locations Received at Brigade are routed to DIOC
DS Bn FDC (TACFIRE)	Target Intelligence	Moving Target Locations	DIVARTY (TACFIRE)	- Interface to DIOC	(1) All Moving Target Locations Received at DS Battalion FDC are routed to DIVARTY
Units In Contact and Other Maneuver Units	Friendly Unit Data	Status of Forces Data	Maneuver Battalion	- Friendly Situation	(1) All friendly Unit Data effecting Maneuver situation is provided through Maneuver Battalion, to Brigade, and then to DIOC

Fig. 4.2-4b MANEUVER INFORMATION ROUTING - RECON PATROLS, UNITS IN CONTACT AND OTHER MANEUVER UNITS

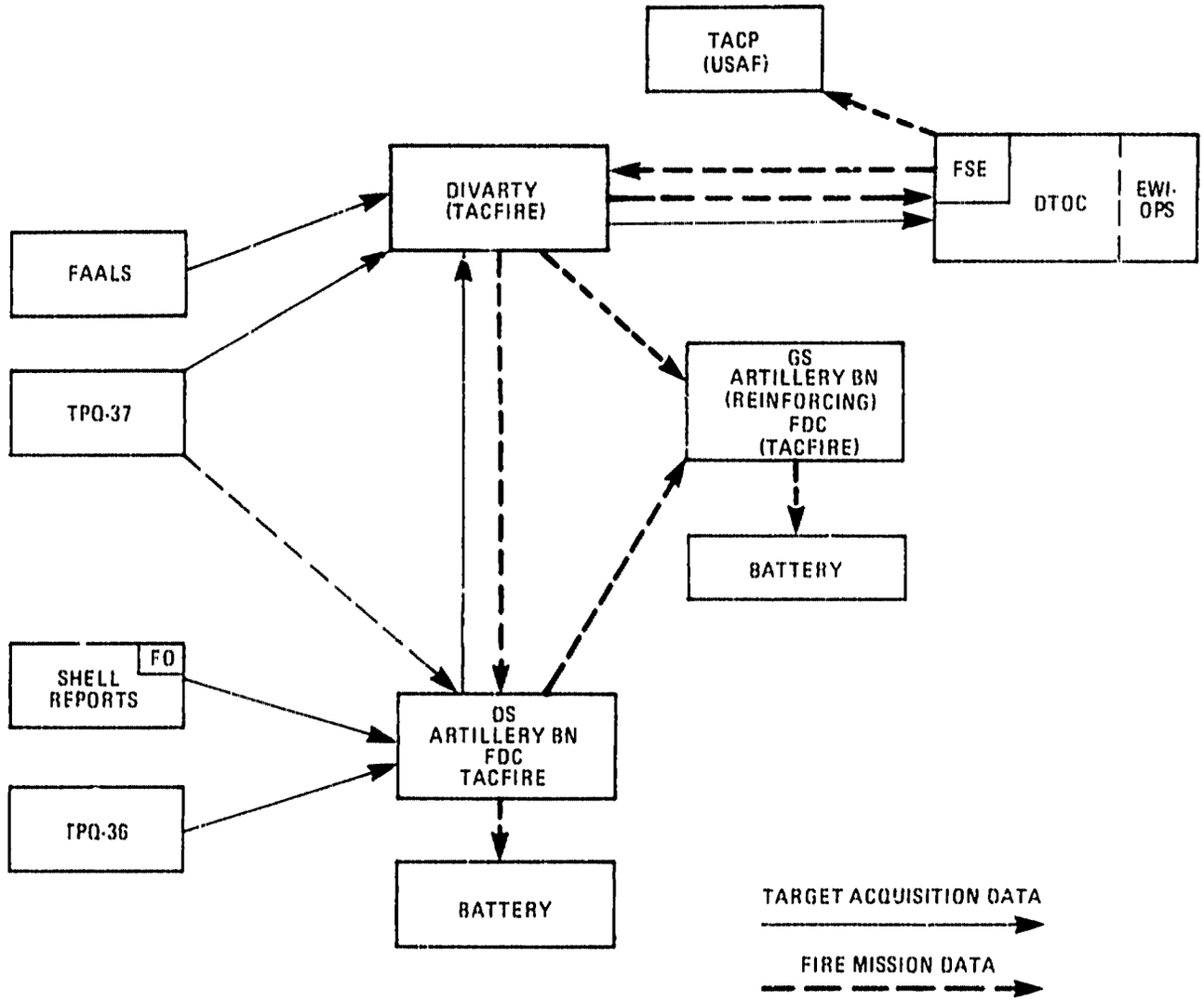


Figure 4.2-5. TARGETING INFORMATION FLOW - SHOOTERS.

of both enemy and friendly maneuver data is indicated, as well as the special case of mover location data for the DTOC maneuver display. In certain cases, this data is embedded in enemy situation messages as opposed to specific mover location summaries. As in Figure 4.2-1 optional or alternate paths are indicated by dashed arrows. This figure is used in conjunction with Figures 4.2-4a, b to define the flow and routing criteria for SOTAS, GSR, and Forward Observer sources. This flow is not meant to imply a separate set of messages for data which has maneuver impact. Rather it indicates how those messages which do have maneuver impact will reach the DTOC. For example, in the case of SOTAS the targeting and maneuver information would be derived from the same message.

Maneuver Data from Reconnaissance Patrols, Units In Contact, and other Maneuver Units are treated separately in Figure 4.2-4b. Again, the table provides the type and content of the data flow, the routing options and the criteria for utilizing a routing option.

4.2.2 Information Flow - Shooters

This subsection addresses the information flow for shooter data which is derived, primarily, from four different sources, i.e., FAALS (Forward Area Acoustic Locating System), AN/TPQ-37 Artillery Locating Radar, AN/TPQ-36 Mortar Locating Radar and Forward Observers associated with other maneuver units.

Target Data Flow - Shooters

Figure 4.2-5 presents the target data flow associated with the detection and initiation of artillery counterfire or air attack against designated enemy shooter targets. The figure indicates the flow of shooter target acquisition data and the resultant flow of transmission

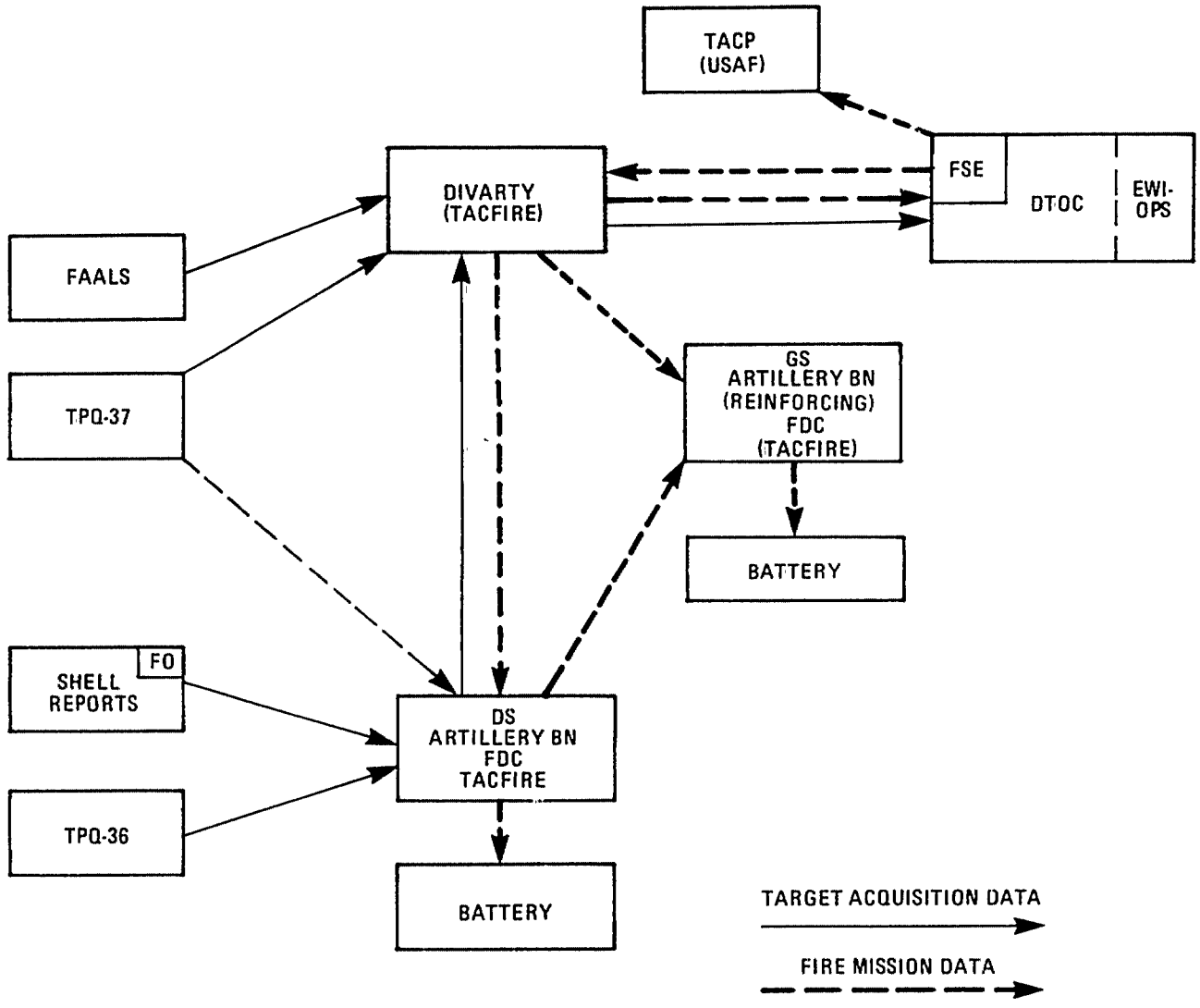


Figure 4.2-5. TARGETING INFORMATION FLOW - SHOOTERS.

of fire mission data for bringing to bear the appropriate weaponry on the enemy shooter target(s). This figure is used in conjunction with Figure 4.2-6a, b, and c to define the flow of shooter target acquisition data from the detection sources and the transmission of fire mission data to the counterfire/attack weaponry.

Maneuver Data Flow - Shooters

Figure 4.2-7 presents the flow of maneuver data from the data sources associated with shooter data. This figure shows the flow of both enemy and friendly maneuver data as well as the special case shooter location data for the DTOC maneuver display. In certain instances the shooter location data may be contained in enemy situation messages as well as in specific shooter location summaries. This figure is used in conjunction with Figure 4.2-8 to define the data flow from the individual sources.

Figure 4.2-8 defines the data flow and routing criteria for the FAALS, AN/TPQ-37, Forward Observer, and AN/TPQ-36 data sources.

4.2.3 Information Flow - Emitters

This subsection addresses the information flow for data derived from SIGINT sensors, viz., Guardrail and Quick Look at the Corps level, and Teampack and Trailblazer at the Division level.

Target Data Flow - Emitters

Figure 4.2-9 presents the flow of target data associated with enemy emitters (radios and radars). As in the case of the Movers and Shooters, the flow starts at the detection source and can be traced to the executing weapon system. The figure shows the data in two categories:

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING ACTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
FAALS.	Target Acquisition.	(1) Calculated hostile artillery locations.	DIVARTY (TACFIRE)	(1) Hostile Artillery - Target correlation - Generate Fire Mission. - Provide hostile artillery locations to DTOC. - Provide target acquisition data to DTOC for decision and action.	All FAALS data forwarded to DIVARTY (TACFIRE). If DIVARTY cannot respond due to type of weapon, range, or non-availability of resources (priorities and/or equipment) passes Fire Mission Request to DTOC for decision/action.
		(2) Calculated location of friendly shell bursts (Registration)		(2) Friendly Artillery - Correction of artillery counter-fire on enemy target(s). - Assessment of mission fire effectiveness	
DIVARTY (TACFIRE)	Fire Mission Request.	Target acquisition data derived from merging or selection of FAALS acoustic location data, TPQ-37 track data and shell reports.	DS Artillery Bn FDC.	Technical Coordination and Fire Command Generation.	Fire Missions that are within the resource capabilities and fire priorities of the DS Battalion.
	Fire Mission Request.		GS Artillery Bn FDC.	Technical Coordination and Fire Command Generation.	All missions that are not provided to or are not supportable by DS battalions.
	Fire Mission Request.	See above.	DTOC.	Generate TACAIR Mission Request.	All counterfire mission requests that cannot be handled by artillery.
		Calcaulted enemy artillery and mortar locations.	DTOC.	- Target correlation - Information for updating shooter's display and SITMAP. - Assessment of friendly counter-fire effectiveness.	DIVARTY (TACFIRE) provides DTOC with all enemy and mortar location data available in TACFIRE data base and assessment of effectiveness of friendly counter-fire measures for update of commander's display and division situation map.
DTOC	Fire Mission Request.	Target acquisition data derived by DIVARTY (TACFIRE) from merging or selection of FAALS acoustic location data, TPQ-37 track data, and/or shell reports and further confirmed by PI and ASACAC data, if available.	TACP (USAF)	- Generate TACAIR Mission.	All Counter-fire Mission Requests which meet the following: - Cannot be engaged through artillery. - Location is within a TACAIR air strike area. - Target is air observeable.
	Fire Mission Request.	Target acquisition data derived from merging of data from Photo ident., SIGINT, and available data from DIVARTY (TACFIRE) target information sources.	DIVARTY (TACFIRE)	- Generate Mission Fire Request(s) to DS and/or GS Artillery Bns.	- DTOC, based on incoming Photo Ident and/or SIGINT data, together with available data from DIVARTY (TACFIRE) (if available), confirms location of threat enemy artillery or mortar as a priority counter-fire target for DIVARTY (TACFIRE).

FIGURE 4.2-6a. TARGETING INFORMATION ROUTING - SHOOTERS.

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
DS Artillery BN FDC (TACFIRE)	Fire Mission.	Fire Command data derived from merging TPQ-36 mortar track data, shell reports, and FO observations.	DS Artillery Battery (TACFIRE)	- Artillery Counter-fire.	- All Fire Missions that are within the resource capabilities and fire priorities of subordinate batteries.
			GS Artillery BN FDC (TACFIRE)	- Technical Coordination and Fire Command Generation.	- Counter-fire Missions that are not within the resource capabilities or priorities of the DS Artillery Battalion.

FIGURE 4.2-6a. TARGETING INFORMATION ROUTING - SHOOTERS (CONT'D)

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
TPQ-37	Target Acquisition.	Calculated hostile artillery locations.	DIVARTY (TACFIRE)	(1) Hostile Artiller . - Target correlation - Generate Fire Mission. - Provide hostile artillery location to DTOC. - Provide target acquisition data to DTOC for decision and action.	(1) All TPQ-37 data forwarded to DIVARTY (TACFIRE). If DIVARTY cannot re ,ond due to type of weapon, range, or non-availability of resources priorities and/or equipment) passes Fire Mission Request to DTOC for decision/action.
			DS Artillery BN FDC.	(2) Generate Fire Mission.	(2) Optional routing based upon the following: - Pre-assigned target area from DIVARTY. - Enemy artillery is sufficiently mobile to demand immediate counter-fire
DIVARTY (TACFIRE)	Fire Mission Request.	Target acquisition data derived from merging or selection of FAALS acoustic location data, TPQ-37 track data and shell reports.	DS Artillery BN FDC.	Technical Coordination and Fire Command Generation.	Fire Missions that are within the resource capabilities and fire priorities of the DS Battalion.
	Fire Mission Request.		GS Artillery BN FDC.	Technical Coordination and Fire Command Generation.	All missions that are not provided to or are not supportable by DS battalions.
	Fire Mission Request.	See above.	DTOC.	Generate TACAIR Mission Request.	All counter-fire mission requests that cannot be handled by artillery.
		Calculated enemy artillery locations.	DTOC.	Target correlation.	DIVARTY (TACFIRE) provides DTOC with all enemy artillery and location data available in TACFIRE for: - All TPQ-37 detections in areas of special interest to DTOC. - All TPQ-37 detections for which no Fire Mission has been generated.
DTOC	Fire Mission Request.	Target acquisition data derived by DIVARTY (TACFIRE) from merging or selection of FAALS acoustic location data, TPQ-37 track data, and/or shell reports and further confirmed by PI and/or SIGINT data, if available.	TACP (USAF)	Generate TACAIR Mission.	All Counter-fire Mission Requests which meet the following: - Cannot be engaged through artillery. - Location is within a TACAIR air strike area. - Target is air observeable.
	Fire Mission Request.	Target acquisition data derived from merging of data from Photo Ident, SIGINT and available data from DIVARTY (TACFIRE) target information sources.	DIVARTY (TACFIRE)	Generate Mission Fire Request(s) to DS and/or GS Artillery Bns.	DTOC, based on incoming Photo Ident and/or SIGINT data, together with available data from DIVARTY (TACFIRE) (if available), confirms location of threat enemy artillery or mortar as a priority counter-fire target for DIVARTY (TACFIRE).

FIGURE 4.2-6b. TARGETING INFORMATION ROUTING - SHOOTERS.

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
DS Artillery BN FDC (TACFIRE)	Fire Mission.	Fire Command data derived from merging TPQ-36 mortar tracking data, shell reports, and FO observations.	DS Artillery Battery (TACFIRE)	Artillery Counter-fire.	All Fire Missions that are within the resource capabilities and fire priorities of subordinate batteries.
			GS Artillery BN FDC (TACFIRE)	Technical Coordination and Fire Command Generation.	Counter-fire Missions that are not within the resource capabilities or priorities of the DS Artillery Battalion.

FIGURE 4.2-6b. TARGETING INFORMATION ROUTING - SHOOTERS. (CONT'D)

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
TPQ-36 FO Shell Reports	Target Acquisition.	Calculated hostile mortar location.	DS BN, FDC (TACFIRE)	Hostile Artillery. - Target correlation. - Generate Fire Mission. - Provide hostile artillery location to DIVARTY.	All data forwarded to DS BN. If DS BN cannot respond due to type of weapon, range, or non-availability of resources (priorities and/or equipment) passes Fire Mission Request to DIVARTY for decision/action.
DIVARTY (TACFIRE)	Fire Mission Request.	Target acquisition data derived from merging or selection of FAALS acoustic location data, TPQ-37 track data and shell reports.	DS Artillery BN FDC.	Technical coordination and Fire Command Generation.	Fire Missions that are within the resource capabilities and fire priorities of the DS Battalion.
	Fire Mission Request.		GS Artillery Bn FDC.	Technical Coordination and Fire Command Generation.	All missions that are not provided to or are not supportable by DS Battalions.
	Fire Mission Request.	See above.	DTOC.	Generate TACAIR Mission Request.	All counter-fire mission requests that cannot be handled by artillery.
		Calculated enemy artillery and mortar locations.	DTOC.	- Target correlation. - Information for updating shooter's display and SITMAP. - Assessment of friendly counter-fire effectiveness.	DIVARTY (TACFIRE) provides DTOC with all enemy artillery and mortar location data available in TACFIRE for: (1) All detections in areas of special interest to DTOC. (2) All mortar and artillery location reports for which no Fire Mission has been generated.
DTOC	Fire Mission Request.	Target acquisition data derived by DIVARTY (TACFIRE) from merging or selection of FAALS acoustic location data, TPQ-37 track data, and/or shell reports and further confirmed by PI and SIGINT data, if available.	TACP (USAF)	- Generate TACAIR Mission.	All Counter-fire Mission Requests which meet the following: - Cannot be engaged through artillery - Location is within a TACAIR air strike area - Target is air observeable.
	Fire Mission Request.	Target acquisition data derived from merging of data from Photo Ident, SIGINT, and available data from DIVARTY (TACFIRE) target information sources.	DIVARTY (TACFIRE)	- Generate Mission Fire Request(s) to DS and/or GS Artillery Bns.	- DTOC based on incoming Photo Ident and/or SIGINT data, together with available data from DIVARTY (TACFIRE) (if available), confirms location of threat enemy artillery or mortar as a priority counter-fire target for DIVARTY (TACFIRE).

FIGURE 4.2-6c. TARGETING INFORMATION ROUTING - SHOOTERS.

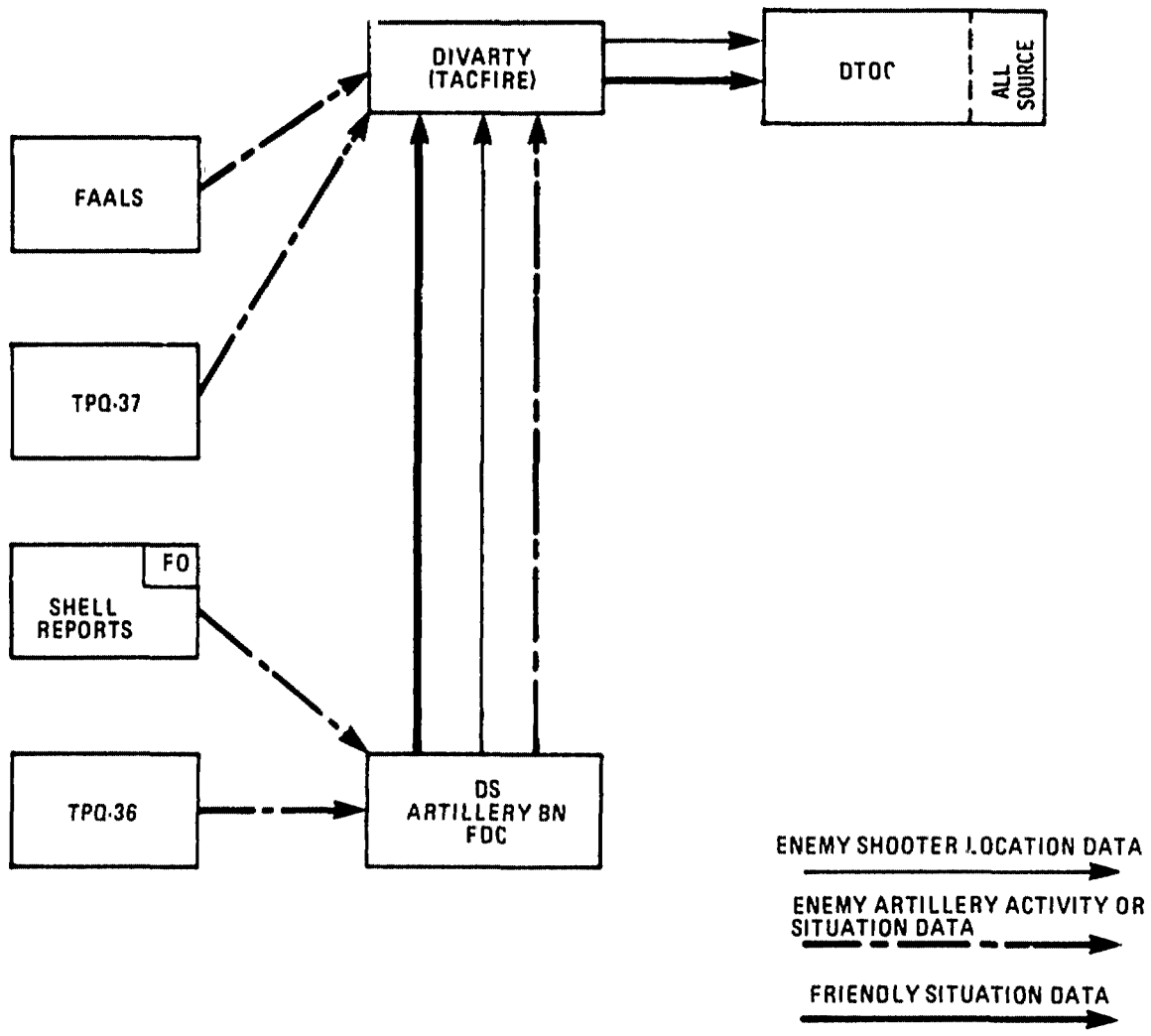


FIGURE 4.2-7. MANEUVER INFORMATION DATA FLOW – SHOOTERS/ARTILLERY

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
FAALS	Target Intelligence.	(1) Calculated hostile artillery locations. (2) Calculated location of friendly shell bursts (Registration)	DIVARTY (TACFIRE)	(1) Provide enemy shooter locations to DIOC. (2) Assessment of mission fire effectiveness of friendly fires.	(1) All FAAL location of enemy shooter data forwarded to DIOC. (2) All FAAL assessment of effectiveness of friendly fire missions forwarded to DIOC.
AN/TPQ-37 Artillery Locating Radar.	Target Intelligence.	Multiple artillery location data.	DIVARTY (TACFIRE)	Provide enemy shooter location to DIOC.	AN/TPQ-37 location data forwarded to DIOC as part of shooter location summary on a periodic basis.
Forward Observer (DS Arty Bn)	Target Intelligence/ Enemy Situation.	Shell Reports.	DS Arty Bn (FDC)	(1) Enemy shooter location data. (2) Enemy artillery activity situation data. (3) Friendly situation data.	(1) Shooter location data forwarded to DIOC via DIVARTY in shooter location summary or a periodic basis unless not sooner requested. (2) Forwarded to DIVARTY. (3) Friendly situation data forwarded to DIOC via DIVARTY.
AN/TPQ-36 Mortar Locating Radar.	Target Intelligence.	Calculated location of enemy mortar.	DS Arty Bn (FDC)	(1) Mortar location data by DS Arty. (2) Enemy mortar activity.	(1) Shooter location data forwarded to DIOC via DIVARTY as part of periodic shooter location summary.

FIGURE 4.2-8. MANEUVER INFORMATION ROUTING - SHOOTERS.

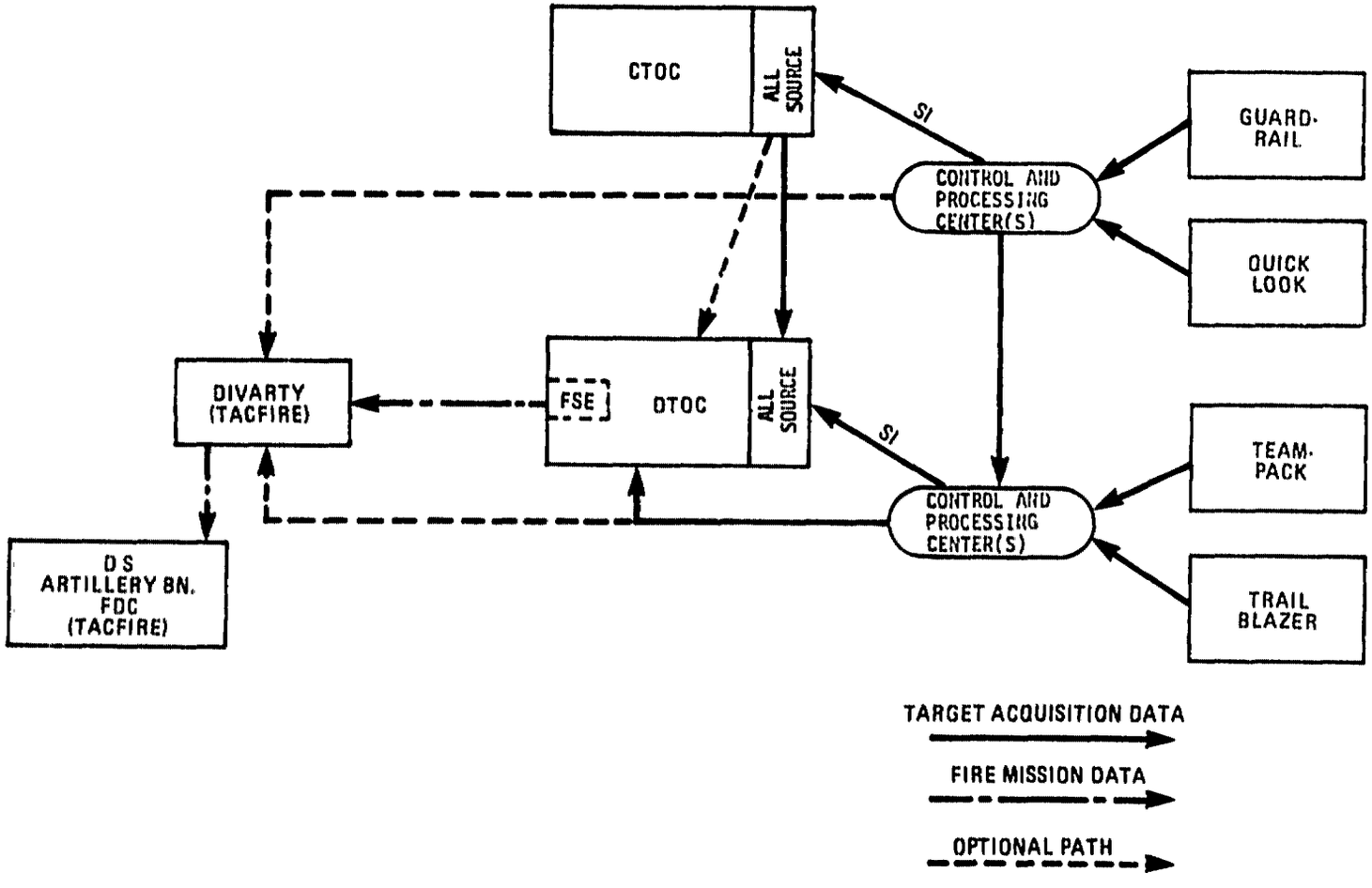


Figure 4.2-9. SIGINT TARGETING MESSAGES (EMITTERS).

1. That which is target acquisition or target intelligence. This information or data precedes the decision to fire.

2. Fire mission requests or fire missions. This type of information follows the designation of a target.

Primary or normal paths are indicated by solid arrows, while optional or alternate paths are illustrated with dashed arrows. This figure is used in conjunction with Figures 4.2-10a, b to define the flow of information for individual sources. Figure 4.2-10b indicates the Target Information Routing criteria for Guardrail and Quick Look derived emitters. The figure indicates not only the type and content of the data but the criteria for utilizing each of the routing options at each node. For example, the Control and Processing Center(s) has three routing options: the Division All Source, the DTOC, or the DIVARTY. The parameters which determine the routing are defined under routing criteria. The specific parameter values must be provided on a periodic basis by the DTOC.

The flow from each node is continued through to the generation of a fire mission by Artillery. The figure (Figure 4.2-10a, b) provides not only theflow options but also indicates the information or command guidance which must be provided to each of the nodes to cause the proper routing.

Maneuver Data Flow - Emitters

Figure 4.2-11 presents the flow of maneuver data from the four sources associated with enemy emitter data. In this figure the flow of enemy maneuver data is included along with the special case of emitter location data for the DTOC maneuver display. This location data is derived strictly from the direction finding of the sensors and not from any technical analysis or translations. It is not, therefore, tied inherently to

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
Guardrail	Target Acquisition.	Airborne Collected COMINT.	Control and Processing Center(s)	Fused with other SIGINT Data.	o All Guardrail Data goes to Control and Processing Center(s).
Quick Look	Target Acquisition.	Airborne Collected ELINT	Control and Processing Center(s)	Fused with other SIGINT Data.	o All Quick Look Data goes to Control and Processing Center(s).
Control and Processing Center(s)	Target Acquisition.	Target Data.	DIVARTY.	Generate Fire Mission.	o Optional routing based upon TACFIRE defined Standing Requests (or Templates) which include: - Specific target types. - Targets located within given distance of FEBA (within Arty Range). - Target location accuracy $< \Delta e$ (error). - CPC can assign high reliability to the above.
Control and Processing Center(s)	Target Acquisition.	Fused SIGINT.	Control and Processing Center(s)	Target correlation. Information only.	o All target information relating to DCAC area of interest.
Control and Processing Center(s)	Target Acquisition.	Fused SIGINT.	All Source	Target correlation. Information only.	o All target data.
All Source	Target Acquisition.	Fused Intell.	All Source DTOC.	Further target refinement Information only. Generate Fire Mission.	o All potential targets falling within division area of interest. o Optional routing based upon FSE defined Standing Requests (or Templates) which include: - Specific targets of interest and (possibly) specific actions by the targets. - Target types with location accuracy $< \Delta e$ (error). - Targets within range of Division Artillery.
DTOC	Fire Mission Data.	Fused Target Data.	DIVARTY (TACFIRE)	Generate Fire Mission.	o All Fire Mission Requests.
DIVARTY (TACFIRE)	Fire Mission Request.	Target Data.	DS Arty Bn. FDC (TACFIRE)	Technical Coordination and Fire Command Generation.	o All Fire Missions that are within the resource capability and fires priorities of the DS Bn.

FIGURE 4.2-10a. TARGETING INFORMATION ROUTING - EMITTERS.

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT A [illegible]	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
Teampack	Target Acq.	Ground Collected ELINT	Control and Processing Center(s)	Fused with other SIGINT Data	o All Teampack Data goes to Control and Processing Center(s).
Trail Blazer	Target Acq.	Ground Collected COMINT	Control and Processing Center(s)	Fused with other SIGINT Data	o All Trail blazer Data goes to Control and Processing Center(s).
Control and Processing Center(s)	Target Acq.	Fused SIGINT	All Source	o Target Correlation o further Target Refire o Info Only	o All Target Data
			DTOC	Generate Fire Mission	o Optional Routing Based upon FSE defined Standing Requests (or Templates) which include: o Specific Targets of Interest and (possibly) specific actions by the targets. o Target Type with Location Accuracy $< \Delta e$ (error) o Targets Within Range of Division Artill.
			Div Arty (TACFIRE)	Generate Fire Mission	o Optional Routing Based upon FSE defined Standing Request (or Templates) which include: - All of previous conditions - Control and Processing Center(s) can assign high reliability to the info.

Fig. 4.2-10b TARGETING INFORMATION ROUTING - EMITTERS

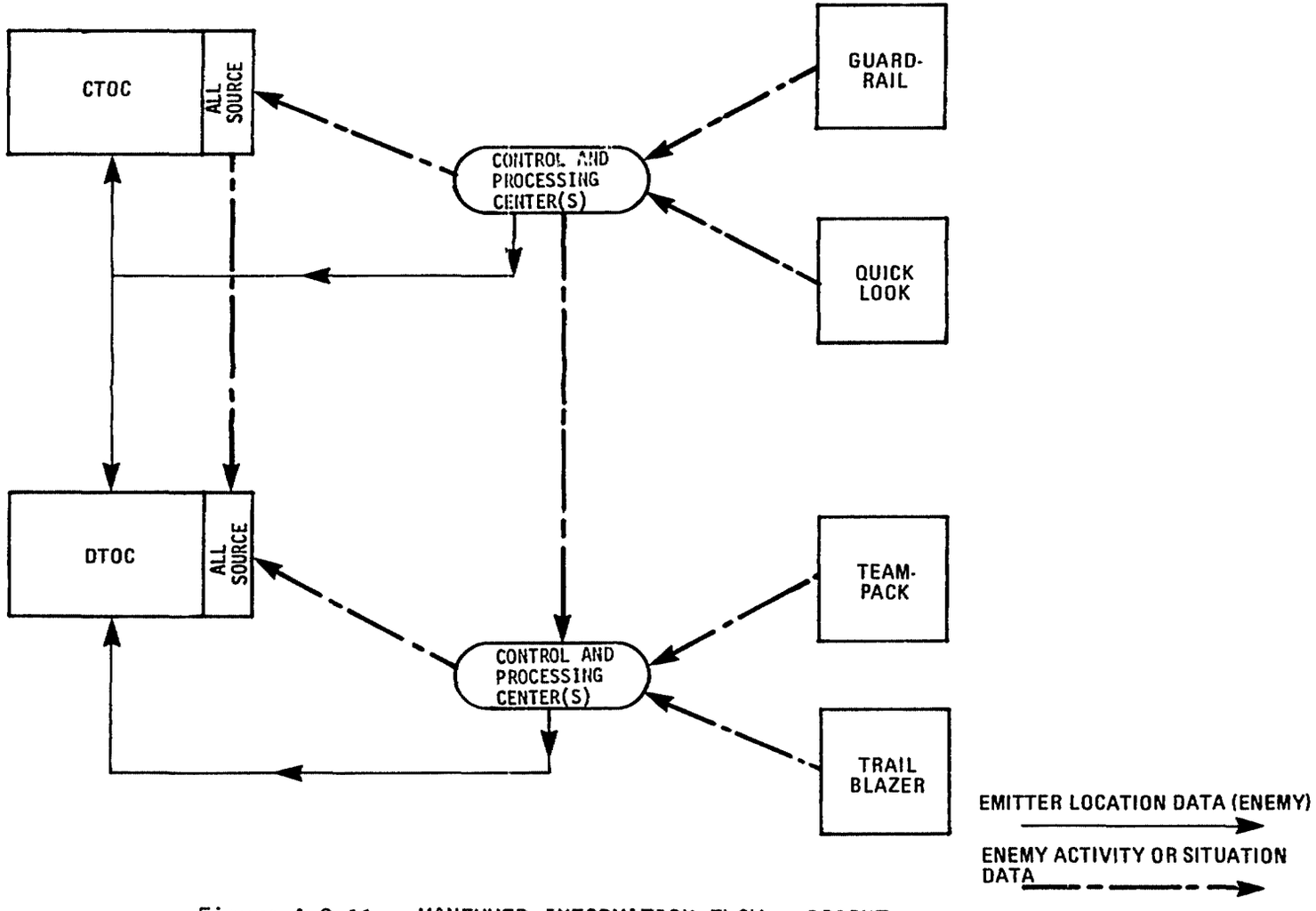


Figure 4.2-11. MANEUVER INFORMATION FLOW - SIGINT.

targeting messages. This figure is used in conjunction with Figure 4.2-12 to define the flow and routing criteria for Guardrail, Quick Look, Teampack and Trailblazer. This flow is not meant to imply a separate set of messages for data which has maneuver impact. Rather, it indicates how those messages which do have maneuver impact will reach the DTOC.

The raw emitter data which reaches the DTOC is shown as being routed through the Control and Processing Center(s). This only indicates a routing path that is transparent to information flow. This data flows directly to the DTOC with no further analysis or processing.

4.2.4 Information Flow - PHOTINT

This subsection addresses the information flow for data derived from photography collected by the Mohawk Aircraft, viz., the OV-1D. This system is treated separately since it collects information on shooters, movers, fixed and emitting (radars) targets as opposed to some one of these categories exclusively.

Target Data Flow - PHOTINT

Figure 4.2-13 presents the flow of target data detected as a result of photographic interpretation. The flow starts at the detection source and ends with the executing weapon system. The figure indicates data in two categories:

1. That which is target acquisition or target intelligence. This information or data precedes the decision to fire.

2. Fire mission request data on fire missions. This type of information follows the designation of a target.

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTIONS	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
Guardrail	Enemy Activity Data	Airborne Collected COMINT	Control and Processing Center(s)	Fused with other SIGINT Data, Determined Radio Locations from DF's	All Guardrail Data Goes to Control and Processing Center(s)
Quicklook	Enemy Activity Data	Airborne Collected ELINT	Control and Processing Center(s)	Fused with other SIGINT Data Determined Radar Locations from DF's	All Quicklook Data Goes to Control and Processing Center(s).
Control and Processing Center(s)	Target Intell.	Fused SIGINT	All Source	Fusion with other Intelligence, Sanitize & Disseminate to to lower Echelons	All SI Data
		Emitter Location	CTOC	Corps Maneuver Display	All COMINT DF's (no target implied), All ELINT DF's (no target implied)
		Emitter Location	DTOC	Division Maneuver Display	All COMINT & ELINT DF's within Division Area of Interest
		SIGINT Data	Control and Processing Center(s)	Fusion with other SIGINT Data	All Non-SI SIGINT Data that meets Area of Interest Criteria
All Source	Target Intell.	Fused ALL-Source Intelligence	All Source	Enemy Situation	All Intelligence Meeting Area of Interest Criteria
Teampack	Enemy Activity Data	Ground Collected ELINT	Control and Processing Center(s)	Fused with other SIGINT Data, Determine Radar Locations From DF's	All Teampack Data Goes to Control and Processing Center(s)
Trailblazer	Enemy Activity Data	Ground Collected COMINT	Control and Processing Center(s)	Fused with other SIGINT Data, Determine Radio Locations From DF's	All Trailblazer Data Goes to Control and Processing Center(s)
Control and Processing Center(s)	Target Intelligence	Fused SIGINT	All Source	All Source Fusion Enemy Situation	All SIGINT Data (both SI and non-SI)
		Emitter Location	DTOC	Division Maneuver Display	All COMINT & ELINT Emitter Locations

Fig. 4.2-12 MANEUVER INFORMATION ROUTING - EMITTERS

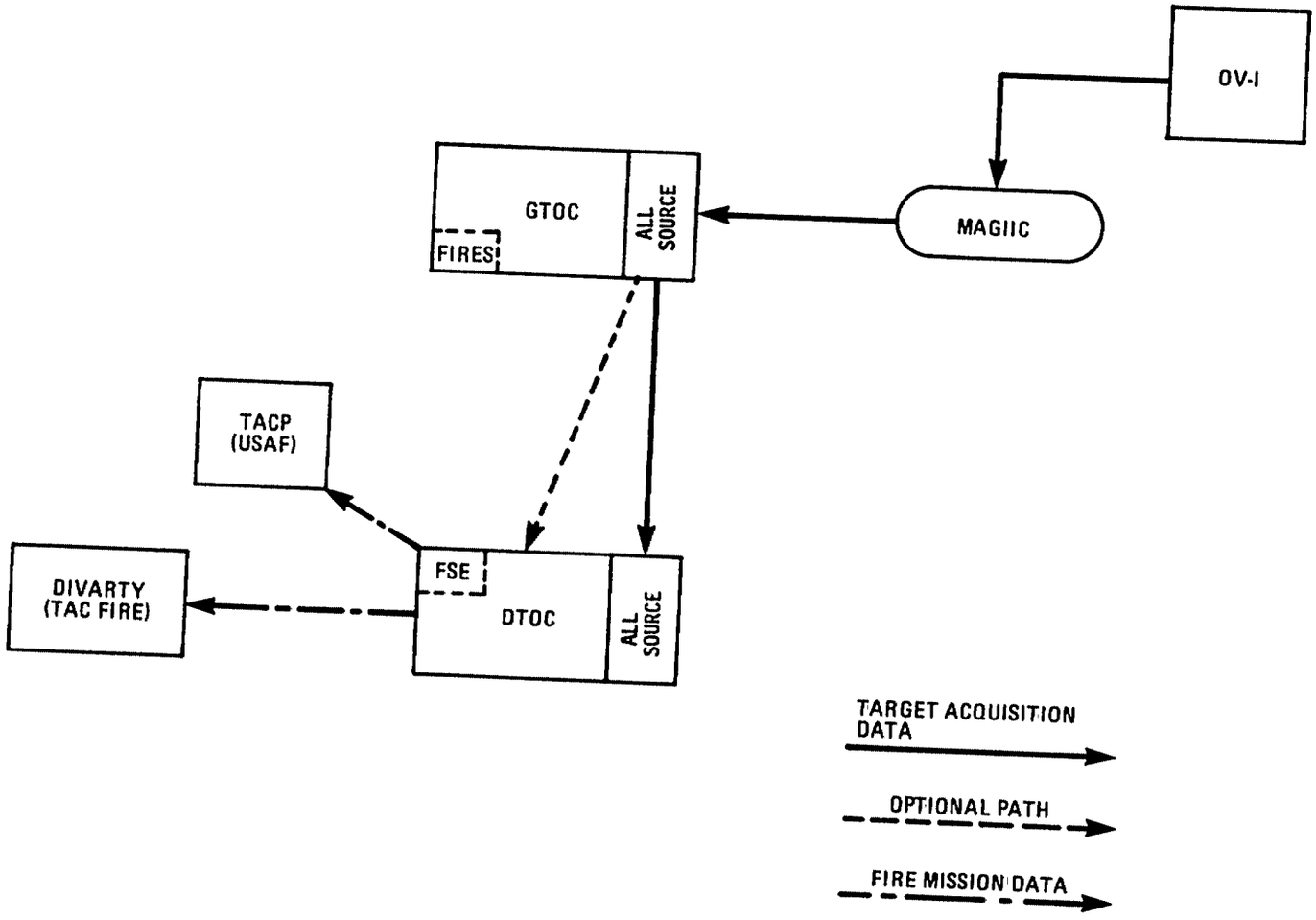


Figure 4.2-13. PHOTINT TARGETING MESSAGES.

Primary or normal paths are indicated by solid arrows, while optional or alternate paths are illustrated by dashed arrows. This figure is used in conjunction with Figure 4.2-14 to define the flow of information for individual sources. Figure 4.2-14 indicates the Target Information Routing criteria for the OV-1D. The figure indicates not only the type and content of the data but the criteria for utilizing each of the routing options at each node. For example, the DTOC has two options: the TACP, or DIVARTY. The parameters which determine this routing are defined under routing criteria. The specific parameter values are provided by the DTOC.

The flow from each node is continued through to the generation of a fire mission by Artillery or TACAIR. The figure (Figure 4.2-14) provides not only the flow options but also indicates the information or command guidance which must be provided to each of the nodes to cause the proper routing.

Maneuver Data Flow - PHOTINT

Figure 4.2-15 presents the flow of enemy maneuver data as derived from the OV-1D. This figure is used in conjunction with Figure 4.2-16 to define the flow and routing criteria for the OV-1D. This flow is not meant to imply a separate set of messages for data which has maneuver impact. Rather, it indicates how those messages which do have maneuver impact will reach the DTOC.

4.3 SYSTEM INTEROPERABILITY ANALYSIS

In the process of defining the DIVRAS concept the key problems driving the interoperability requirements were:

1. timely data routing (which reduc - both the time and the amount of data reported between ..nsor nodes and using nodes)

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
OV-1D Aircraft.	Target Acquisition.	Unprocessed photographic film.	MAGIIC.	Photo interpretation and photogrammetry.	o All unprocessed film must go through MAGIIC.
MAGIIC.	Target Acquisition.	Accurate detection, identification and location of potential targets.	All Source	Correlate with other source inputs. Determine users and disseminate.	o All processed and interpreted film go to All Source.
All Source	Target Acquisition.	Fused target information.	All Source	Refinement of target information. Determine division user and disseminate. Information only.	o All target information.
All Source	Target Acquisition.	Target identification and locations.	DIOC.	Target correlation.	o Optional routing based upon FSE defined standing requests for information (or template) which include: - Specific target types of interest. - Target types with location accuracy $< \Delta e$ (error). - Targets within range of Division Artillery.
All Source	Target Acquisition.	Fused and refined target information.	DIOC.	Target correlation.	o All target information.
DIOC.	Fire Mission Request.	Detailed target data.	TACP.	Generate TACAIR Mission.	o All Fire Mission Requests which meet the following: - Cannot be engaged through artillery. - Location is within TACAIR strike area. - Target is air observeable.
			Div.Arty. (TACFIRE)	Generate Fire Mission.	o All Fire Mission Requests which meet the following: - Within range of Division Artillery. - Location accuracy $< \Delta e$ (error). - Target performance $< \Delta t$ (response time). - Target type indicates artillery effective.

FIGURE 4.2-14. TARGETING INFORMATION ROUTING - PHOTINT.

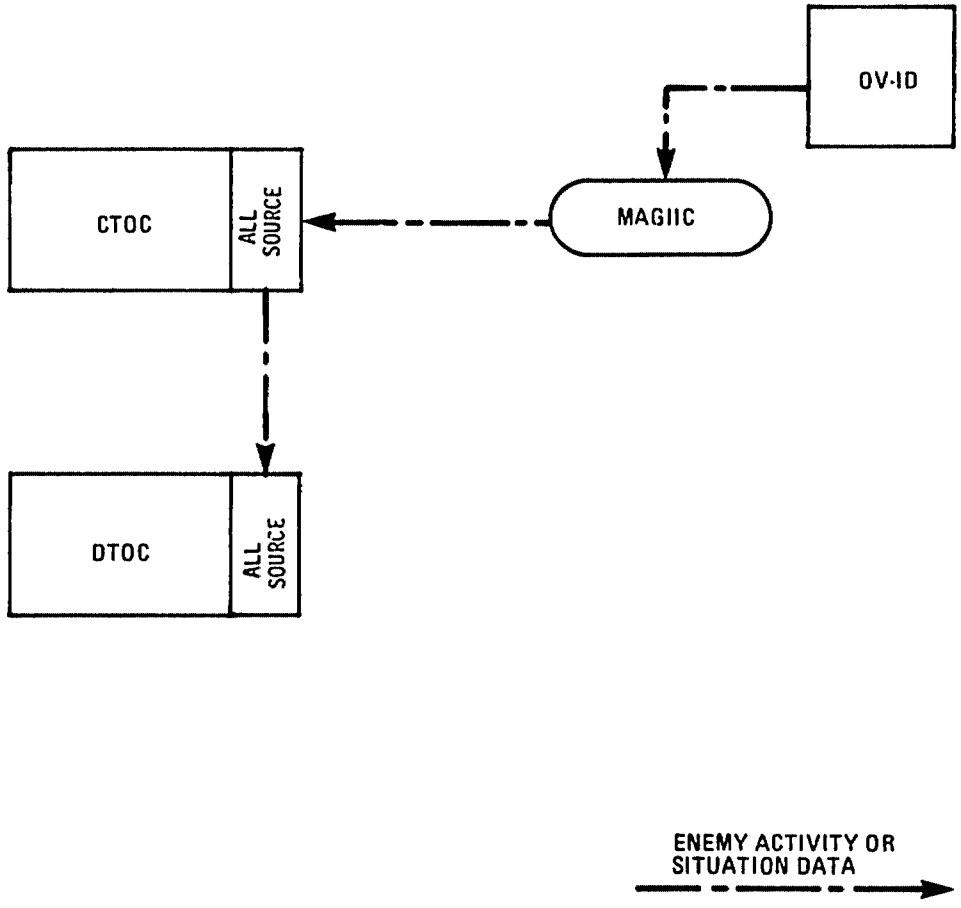


Figure 4.2-15. MANEUVER INFORMATION FLOW - PHOTINT.

SOURCE NODE	OUTPUT DATA TYPE	OUTPUT DATA CONTENT	ROUTING OPTION	OUTPUT DATA UTILIZATION	ROUTING CRITERIA
OV-1D	Raw, Unprocessed Target Intelligence.	Airborne collected photographic intelligence.	MAGIIC	Processing and interpretation.	All OV-1D film must be wet processed at MAGIIC.
MAGIIC	Target Intelligence.	Interpreted imagery.	All Source	Intelligence fusion.	All MAGIIC Reports sent to Corps All Source for fusion.
All Source	Target Intelligence.	Detailed target description (location, type, number, etc.)	All Source	Enemy situation.	All division related data based on area of interest.

FIGURE 4.2-16. MANEUVER INFORMATION ROUTING - PHOTINT.

2. translation (which permits each node's informational needs to be satisfied with minimal impact to other nodes

3. inference (which permits each node to report the message/data elements which it can and infers other needed information as required.

The DIVRAS concept for interoperability summarized on Figure 4.3-1 and further explained in paragraphs 4.3.1 and 4.3.2 embodies solutions which address these key problems. The basic concept portrayed on Figure 4.3-1 shows that the interface between the division TOC and its key interfacing information sources consists of a data routing and guidance link and two primary informational streams.

The two types of informational streams reported to the DTOC are the target message stream and the raw shooter/mover/emitter activity data stream. Two of the interfacing systems, namely, DIVARTY and the division SIGINT sources would transmit both types of informational streams to the DTOC. CORPS and the subordinate echelons would only transmit the message stream to the DTOC and not transmit raw data. All SOTAS reports would be message reports and would feed both the maneuver activity display and the targeting system.

Since the division TOC is in receipt of formatted message data from five key interfaces, the DIVRAS concept postulates a processing requirement which is capable of formatting, translating and inferring message data coming into and going out of the division TOC. The raw data being received from the DIVARTY, SOTAS, and division SIGINT sensors, however, is directly fed (with minimal processing) into the maneuver section activity displays.

The interoperability concept provides for the division TOC to control (by data routing instructions) 1) the direct routing of select sensor data

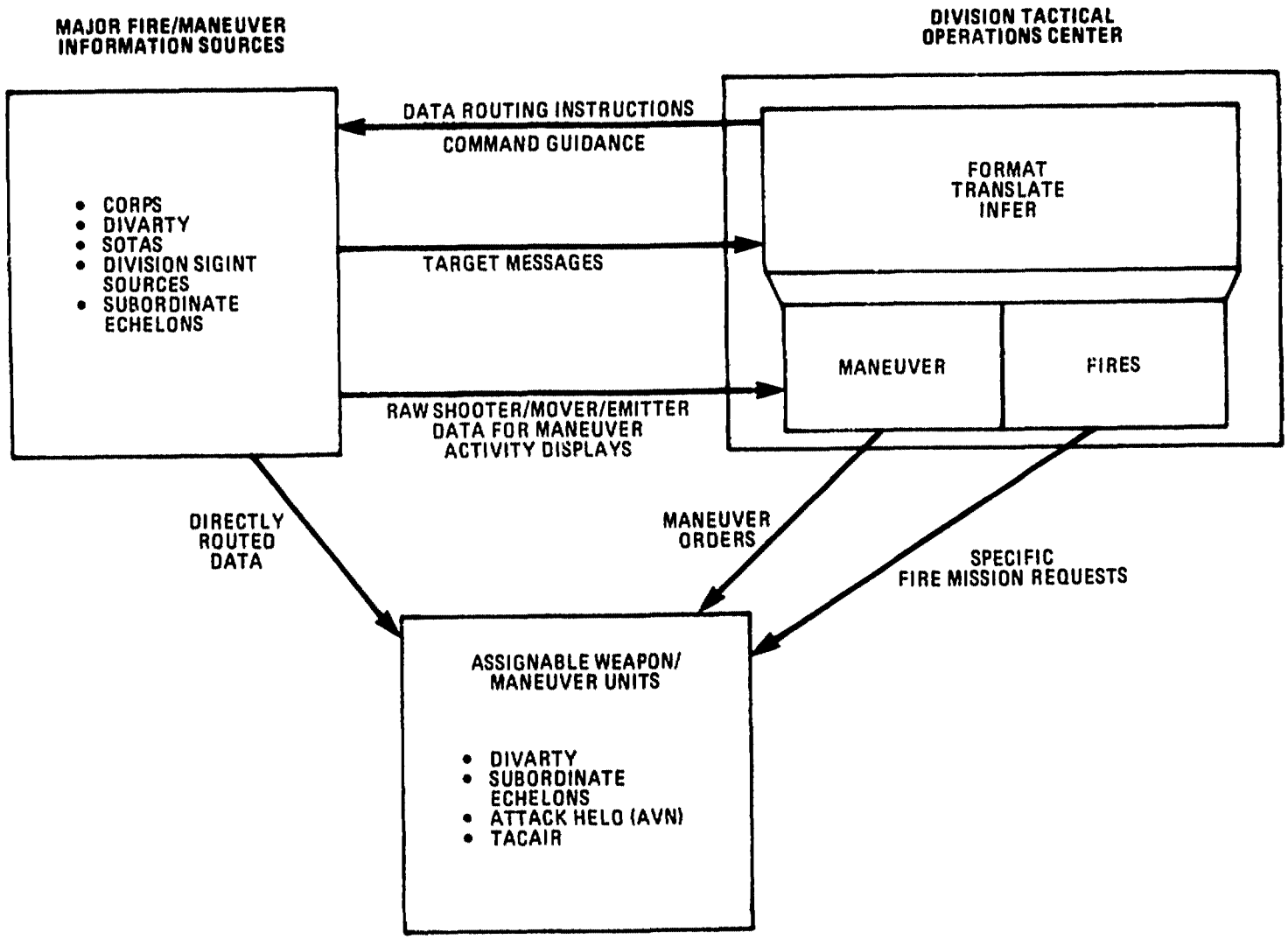


FIGURE 4.3-1 INTEROPERABILITY

to specified weapon systems or subordinate echelon units; as well as, 2) the type and volume of target messages reported to itself.

4.3.1 System Message Exchange for Targeting and Maneuver

The following subparagraphs indicate the message exchange and raw data exchange requirements between the DTOC and the five principle interfaces to support targeting and maneuver.

SOTAS - DTOC

Figure 4.3-2 indicates the SOTAS-DTOC message exchange requirements. The dominant flow is the SOTAS to DTOC TRACK(S) REPORT category. This represents "as required" reporting (S02, S03, and S06) as well as periodic update on specifically requested tracks (S04 and S05). The DTOC controls this reporting by infrequent transmission of either the SOTAS High Interest Request or the Specific Track(s) Request messages.

The DTOC is capable of querying SOTAS, and for each query would receive a query response message (S01) from SOTAS.

Finally, the DTOC is capable of transmitting command guidance to SOTAS which would provide direct reporting instructions, as well as battlefield geometry to be used by the SOTAS ground station equipment and personnel in performing their function of tracking and analysis.

Division SIGINT Sources - DTOC

Figure 4.3-3 indicates the division SIGINT - DTOC message and raw data exchange requirements. The dominant flow is the SIGINT to DTOC transmission of SIGINT Target Report data and separately, the raw emitter location data. The sources of this data can be threefold. The raw

**AUTOMATED SYSTEM MESSAGE EXCHANGE (INTEROPERABILITY)
TO SUPPORT REAL TIME TARGETING/MANEUVER**

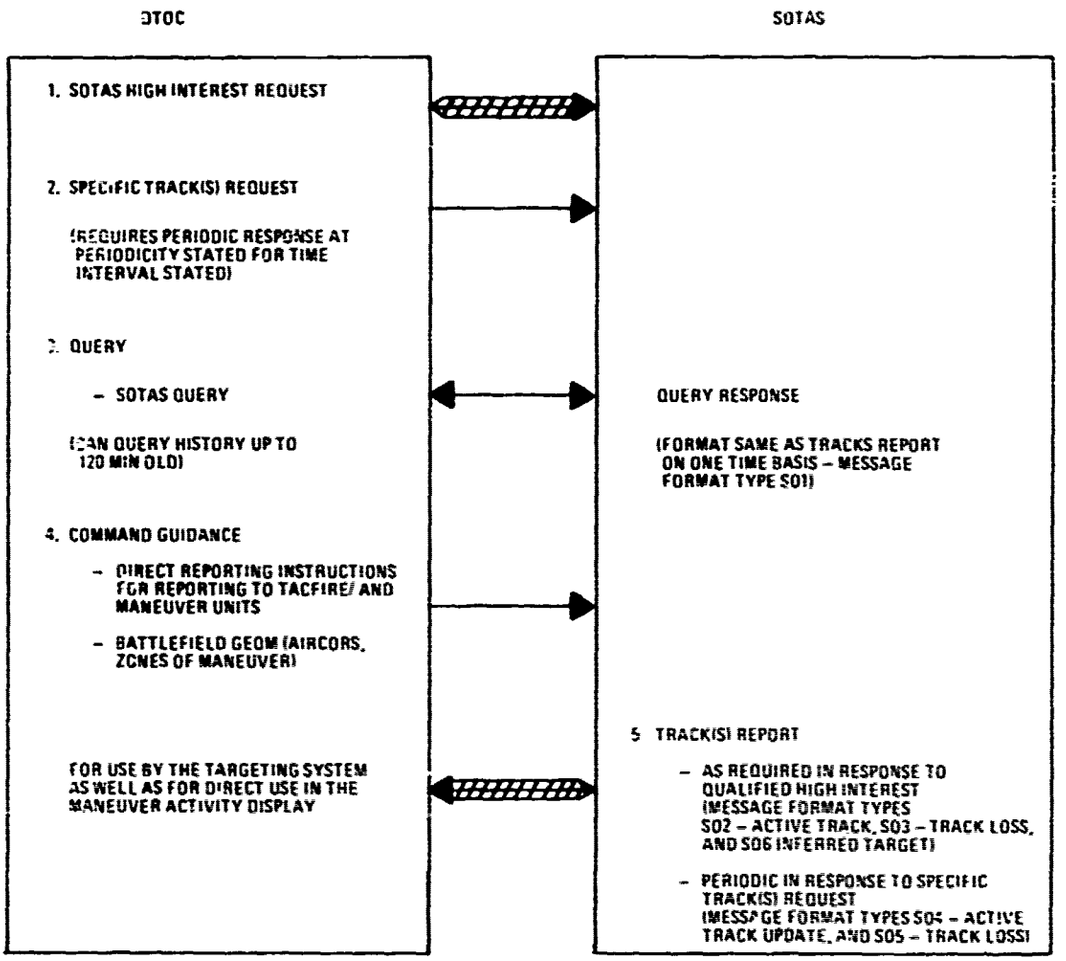


Figure 4.3-2. SOTAS - DTOC.

AUTOMATED SYSTEM MESSAGE EXCHANGE (INTEROPERABILITY)
TO SUPPORT REAL TIME TARGETING/MANEUVER

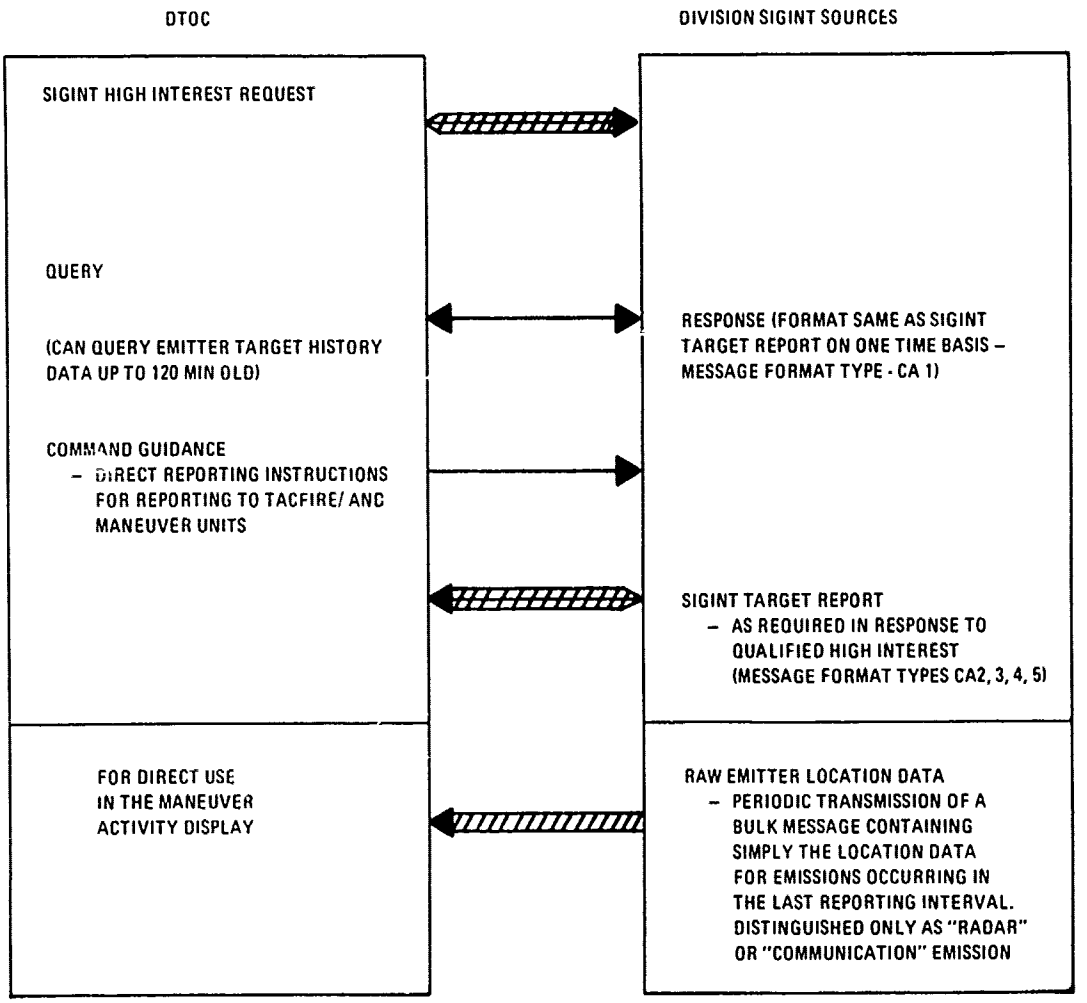


Figure 4.3-3. DIVISION SIGINT SOURCES - DTOC.

emitter location data would be provided directly to the DTOC without analysis or further processing. The Target Report data can be reported from an intermediate processing center, e.g., as the CPC, or can be the result of electronic order of battle analysis at the Control and Analysis Center (CAC).

As in the previous SOTAS - DTOC interface, the DTOC can establish its high interest SIGINT Target Report needs by infrequent transmission of the SIGINT High Interest Request message.

Likewise, it can query emitter target history data as well as control any direct reporting via command guidance.

DIVARTY - DTOC

Figure 4.3-4 portrays the exchange requirements between DIVARTY - DTOC. A principle difference between this interface and the two previously discussed is that a system (TACFIRE) is already defined for DIVARTY, therefore the interoperability in this case attempts to make use of that existing system interface. Thus the DIVRAS formatting, translating and inference processing would be required to accommodate existing TACFIRE interfaces and formats where possible. The DTOC, when wanting to report a target to TACFIRE would utilize the TACFIRE ATI,CDR or AZR format. When the DTOC would want to transmit a fire mission request to TACFIRE, it would do so using a standard TACFIRE fire mission format. Likewise, the DTOC DIVRAS would be required to receive a mission request from TACFIRE, usually in the form of a request for additional fire or a request to address a target out of artillery reach. In this case, the DIVRAS processing would expedite such a request to the appropriate weapon agent adding as much target value as possible from the DTOC vantage point.

AUTOMATED SYSTEM MESSAGE EXCHANGE (INTEROPERABILITY)
TO SUPPORT REAL TIME TARGETING/MANEUVER

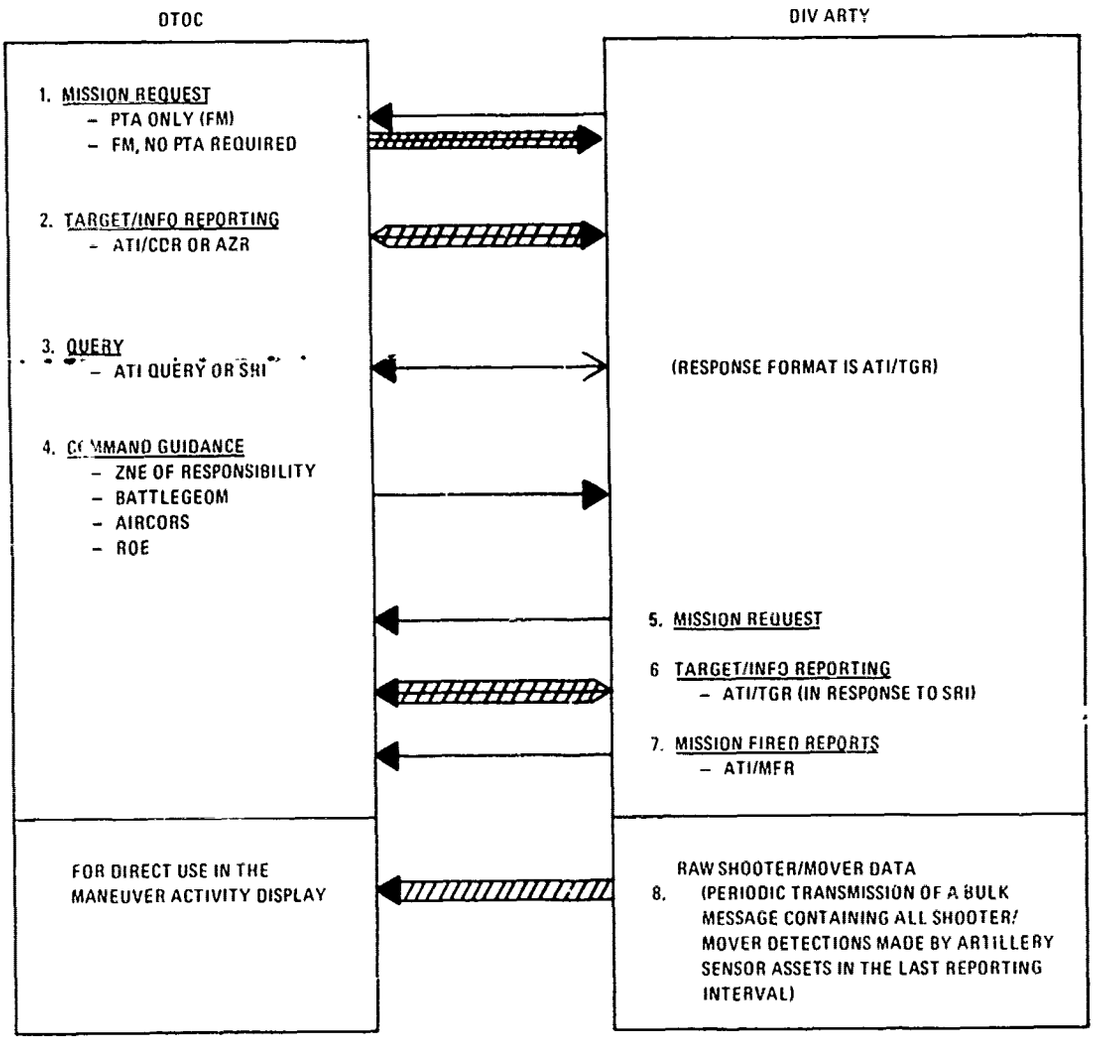


Figure 4.3-4. DIVARTY - DTOC.

The DTOC controls the nature of target message reporting to DTOC from TACFIRE by posting an ATI/SRI request with TACFIRE. This existing SRI capability is therefore assumed here in lieu of the high interest request messages shown on the previous two interfaces. Likewise, TACFIRE is able to respond to such a target reporting request by reporting as required in the ATI/TGR format.

The only interface requirement shown on Figure 4.3-4 which is not supported at least in concept by the existing TACFIRE system is the raw shooter/mover data required from the DIVARTY counterfire and target acquisition elements for direct use in the DTOC maneuver activity display.

CORPS - DTOC

Figure 4.3-5 portrays the CORPS - DTOC exchange requirements. The dominant flow is the flow of SIGINT/PHOTINT targeting message data from CORPS to DTOC in support of the real-time concept.

Subordinate Echelons - DTOC

The interface between subordinate echelons and DTOC is postulated in the DIVRAS concept to be the same as it is in the current TOS concept with the exception that incoming ENSIT/FRENSIT data be screened for targeting/maneuver impact (on a no delay basis) before it enters the TOS intelligence and operational planning data base system. In this manner, information of immediate importance to targeting or maneuver can be expedited at the time of input to the division TOC.

4.3.2 Message Content Analysis

This paragraph summarizes the results of the message content analysis to support the DIVRAS concept. In order to accept, process and data base

AUTOMATED SYSTEM MESSAGE EXCHANGE (INTEROPERABILITY)
TO SUPPORT REAL TIME TARGETING/MANEUVER

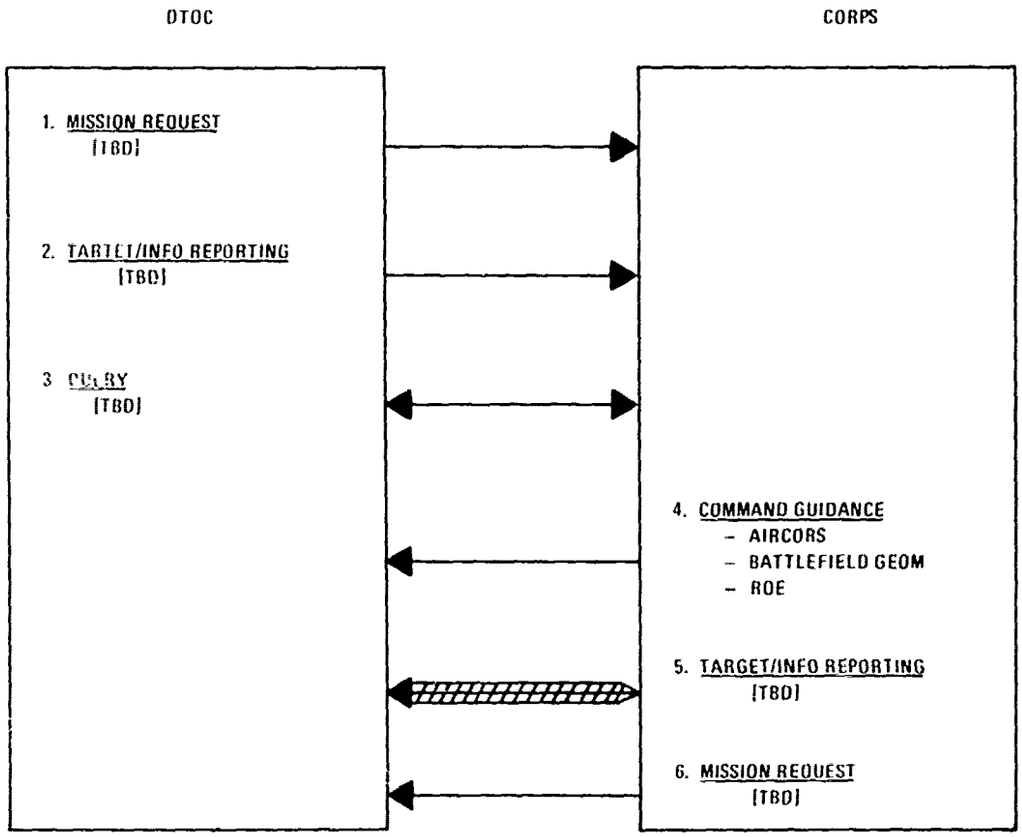


Figure 4.3-5. CORPS - DTOC.

target message data from all systems, a basic enemy record was identified which consisted primarily of enemy unit oriented data, target oriented data and remarks data which included target pertinent information as well as free text remarks. The overall information contained in this record is shown on Figure 4.3-6.

Such a record supports targeting and permits interoperation with all of the required interfaces. Of course, none of the interfaces report all information elements. For example, an enemy activity report from a subordinate echelon will report some of the enemy unit data fields, the basic activity subject, location and time and possibly some free text portion of the remarks. SOTAS or TACFIRE on the other hand, may report many of the target oriented fields but none of the unit oriented fields.

SOTAS - DTOC

The basic message content for a SOTAS track report is shown on Figure 4.3-7. DIVRAS would be required to accept this message and would infer the indicated elements if not reported as well as filling in or inferring other fields in the overall record of Figure 4.3-6 as required (e.g., the current time which DIVRAS received the message, the location error, the target worth, and the target permanence equal to zero if the track was a moving track as indicated by the message type of the report).

Division SIGINT -DTOC

The basic SIGINT target report is indicated on Figure 4.3-8. It is similar in form to the SOTAS track report. However, it contains target characteristics (such as radar type when reported subject is "radar"), as well as enemy unit identification based on SIGINT analysis.

The raw emitter location data can be transmitted in a simple bulk message format as shown on Figure 4.3-9.

FLD NAME	MSG. FORMAT TYPE (4 A/N)	DIRECT REPORTING FLAG (2 A/N)	AGENCY (5 A)	ORIG./NO. (6 AN)	METHOD OF DETECTION (6A)	TGT'D (Y/N) (1A)	REPORT RELIABILITY (EVAL) (2 A/N)	REPORT PRIORITY (SIGNIF) (1A)

FLD	EN-UNIT (26 AN)	EN-PARENT (26 AN)	NATION (2A)	UNIT DEPLOYMENT STATUS (2 AN)

FLD	SUBJECT (OR TYPE) OR OBSERVATION (6A)	ACTIVITY (OR SUB-TYPE) (6A)	LOCATION MGR (8 AN)	EVENT TIME (11 A/N)	QTY. (5N)	TARGET DESCRIPTION			
						MOBIL-ITY (2A)	HARD-NESS (2A)	TARGET CATEGORY (7 AN)	TGT. WORTH (2 AN)

FLD	TGT (OR TRACK) REF. NO. (6 A/N)	ORIGIN (18 AN)	DESTINATION (18 AN)	LOCATION ERROR (3N)	DIRECTION (3 A)	VELOCITY (3 N)	MAINTE-NANCE (3N)

FLD	TARGET CHARAC-TERISTICS (10AN)	CURRENT TIME (11 AN)	COMBAT POWER % (3 N)	

REMARKS: (TO INCLUDE)

FLD	CONFIRMATION STATUS (3A)	ENGAGEMENT STATUS (5A)		CONFIRMED DESTRUCT. REQUIRED (3A)	AIR DEFENSES AROUND TGT. (2A)	OBSERVABILITY (4A)	OTHER
		STATUS	WPN SYS				

Figure 4.3-6. COMMON INTERNAL DIVRAS FORMAT FOR ENEMY UNIT/TARGET REPORT.

X	Ø	X	X	X
MESSAGE TYPE	QUERY REQUEST NUMBER	TRACK #	EVENT DATE/TIME	DIRECT REPORT

REQUIRED ON ALL QUERY RESPONSES FROM SOTAS (MESSAGE TYPE SC1)

X	I	X	Ø	Ø	Ø
TYPE/SUBJECT	TARGET CATEGORY	LOCATION	DIR	VEL	QTY

I	I	
TRACK ORIGIN	TRACK DESTI-NATION	REMARKS

LEGEND:

X – REQUIRED
Ø – OPTIONAL
I – INFERRED

FIGURE 4.3-7 SOTAS TRACK REPORT

REQUIRED ON ALL QUERY RESPONSES FROM DIVISION SIGINT (MESSAGE TYPE CA 1)

X		X	X	X
MESSAGE TYPE	QUERY REQUEST NUMBER	TARGET REFERENCE NUMBER	EVENT DATE/TIME	DIRECT REPORT

X	I	X	0	0	0
TYPE/SUBJECT	TARGET CATEGORY	LOCATION	TARGET CHARACTERISTICS	ENEMY UNIT IDENTIFICATION	LOCATION ERROR

0
REMARKS

LEGEND:

X – REQUIRED
O – OPTIONAL
I – INFERRED

FIGURE 4.3-8 DIVISION SIGINT TARGET REPORT

TYPE
CODE IS

R – RADAR EMITTER
C – COMMUNICATIONS
EMITTER

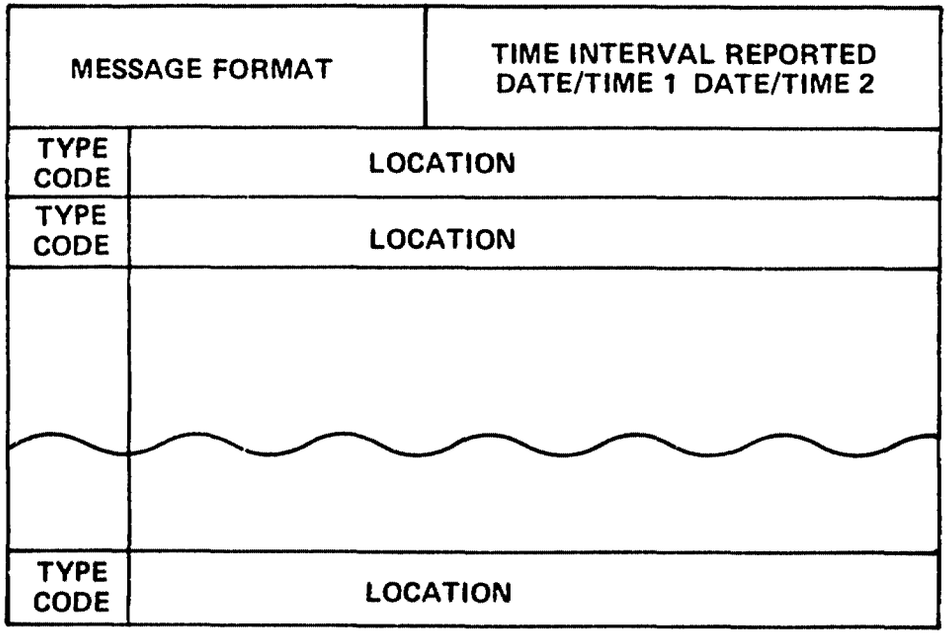


FIGURE 4.3-9 RAW EMITTER LOCATION DATA FORMAT TO SUPPORT MANEUVER EMITTER ACTIVITY DISPLAY

DIVARTY - DTOC

The DIVARTY - DTOC message content analysis, as has been previously discussed, resulted in interfacing with the existing TACFIRE formats and using most of the TACFIRE element data.

The format for the raw shooter and mover data required from the DIVARTY counterfire and target acquisition elements to support the DTOC real time activity display could again be reported in a bulk message format akin to that shown on Figure 4.3-9. However, this time the code would indicate shooter or mover location and in the case of a mover location entry, the quantity of movers would be reported when known.

Corps - DTOC

For targeting message data, the message content analysis for Corps - DTOC indicated that the dominant reporting was in the SIGINT/PHOTINT area and may therefore be supported by a message format similar to that shown on Figure 4.3-8.

Subordinate Echelons - DTOC

For targeting, enemy unit, and enemy activity reporting from subordinate echelons, including troops in contact, the message content analysis indicated the TOS ESDA format, modified to include some target oriented fields, would be appropriate.

SECTION 5. TARGET DATA ROUTING FUNCTION

This section presents a description of the DIVRAS Target Data Routing function in terms of functional concept, processing algorithms, and capability features. As such, this section is divided into three logical parts: Subsection 5.1 discusses the functional concept to provide overall context; Subsection 5.2 details the processing algorithms, which are the primary means for function operation; and Subsection 5.3 summarizes the capability features.

5.1 FUNCTIONAL CONCEPT

The primary objective of the DIVRAS Target Data Routing function is to enhance the DTOC process of real time execution of weapons and forces consistent with recent tactical concepts. Figure 5.1-1 presents an overview of the concept in terms of the basic functional flow (i.e., inputs, sub-functions (processes) and outputs. Real time target intelligence messages, as input from four major interfacing nodes (TACFIRE, SOTAS, CAC, CORPS) are processed through three principal subfunctions: data base update, target presentation, and monitored area summary. All target data received from the interfacing nodes will update the targeting data base which in turn will directly support operation of the target presentation and monitored area summary subfunctions. In addition, the targeting data base will provide the targeting analyst with current targeting information on an on-demand or ad-hoc basis via a query capability. The target presentation subfunction is the heart of the Target Data Routing function. Based on a priori rules and criteria, which are set and controlled by the targeting analyst, incoming target messages are processed through the target presentation subfunction, which:

- Automatically determines if the target data contained in those messages is sufficiently of high enough interest to warrant the

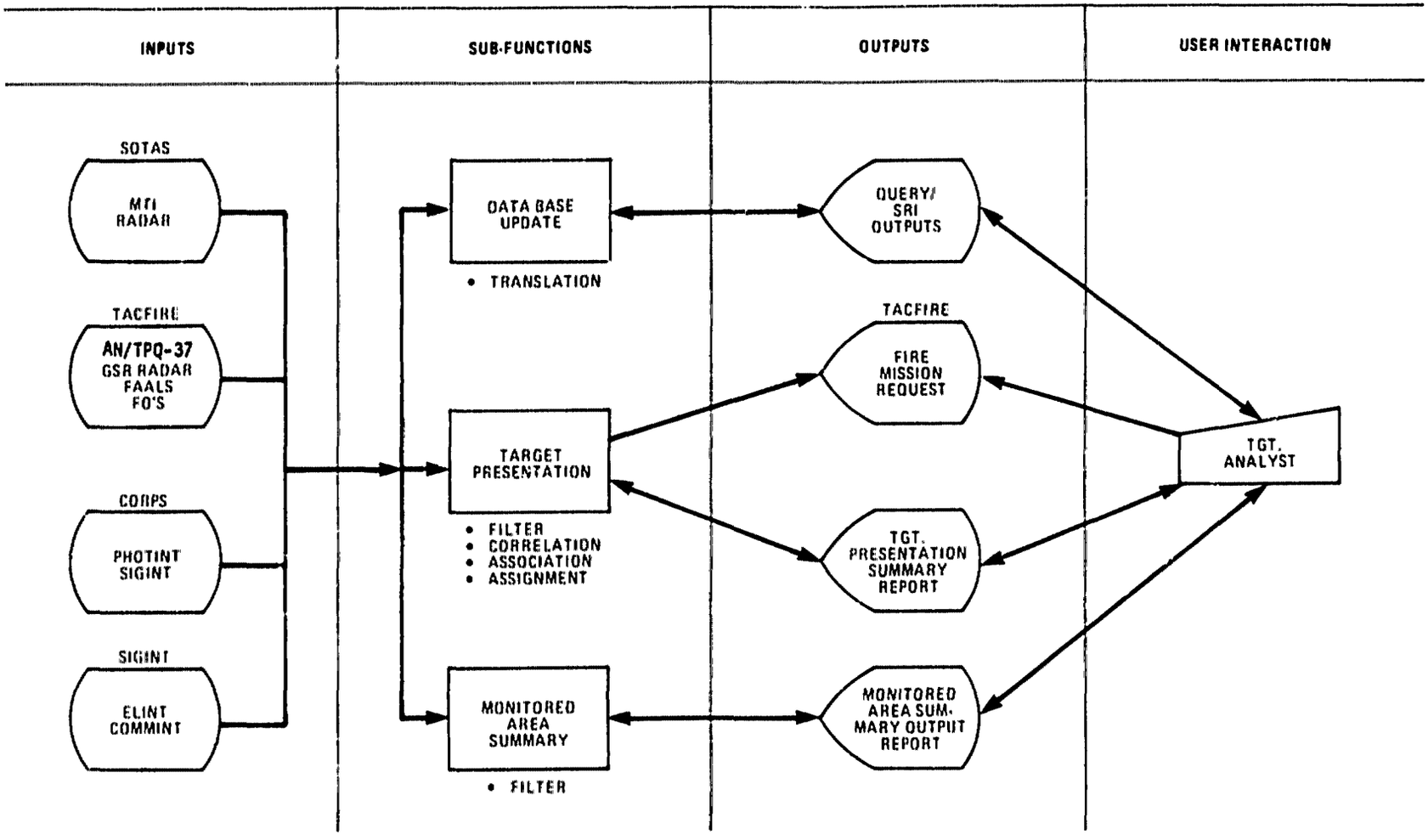


Figure 5.1-1. TARGET DATA ROUTING FUNCTIONAL CONCEPT.

targeting analyst's immediate attention, in which case an output report is directly routed to him for review and possible action.

- Automatically determines if the individual targets reported are, in and of themselves, of high enough value to warrant a fire mission recommendation and subsequent assignment and routing to the appropriate weapon system (i.e., TACFIRE, Helo, or TACAIR) for immediate strike action.

Similarly, the monitored area summary subfunction is used to determine if an incoming target causes exceeding a previously established threshold in a specified monitored area, in which case an output report is directly routed to the targeting analyst for review and action.

The Target Data Routing subfunctions operate principally through a series of supporting algorithms, namely: translation, inference, filter, correlation, association, and assignment. These algorithms provide the logic (rules) and parameters(criteria) necessary for functional operation and may be set and controlled (i.e., tailored) by the targeting analyst consistent with an ever-changing battlefield targeting environment. Each of these algorithms is discussed in detail in the subsequent section.

5.2 TARGET DATA ROUTING ALGORITHMS

The target Data Routing algorithms were developed to support operation of the three major subjunctions described above. They were designed to be particularly responsive to the targeting analyst's need for:

- flexible man-machine interface

- easy to use man-machine dialogue scheme

- minimization of workload in a data-rich (i.e., voluminous message traffic) environment.

Figure 5.2-1 shows an overview of algorithm operation and interrelationships. Each algorithm is briefly described below and detailed in the subsequent subsections.

- Translation Algorithm

  The logic through which target input and output data is translated into an easy to use English-like language to facilitate data reporting and man-machine dialogue. This algorithm supports all three major subfunctions.

- Inference Algorithm

  The logic through which those data element values critical to the three major subfunctions may be derived from related target data elements reported by the target acquisition systems. The inference algorithm also supports all three major subfunctions.

- Filter Algorithm

  The logic through which an incoming target's high interest value is determined, based on parameters set and controlled by the targeting analyst. The major utility of the filter algorithm is to the target presentation and monitored area subfunctions operation.

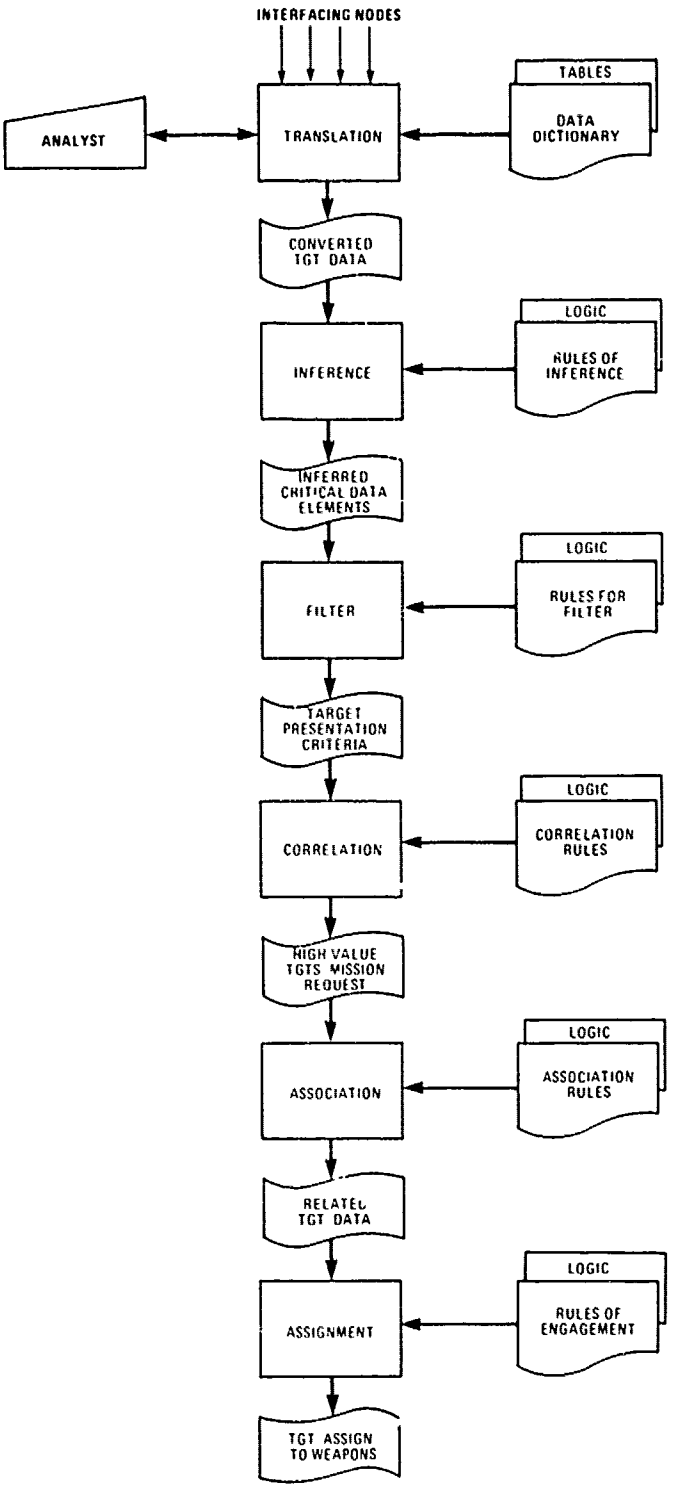


Figure 5.2-1. TARGET DATA ROUTING ALGORITHMS.

- Correlation Algorithm

  Logic through which an incoming target's value is determined through high value correlation tests. Based on these tests, a target may be recommended for a fire mission and directly routed to the appropriate weapon system for immediate strike action. This algorithm is the heart of the target presentation subsystem.

- Association Algorithm

  Logic through which incoming target data is associated with previously reported target data stored in the data base to determine target relationships to increase the information value of any individual target. Major utility is to the target presentation subfunction.

- Assignment Algorithm

  Logic through which a target is assigned to a specific weapon system based on the commander's rules of engagement. Major utility is to the target presentation subfunction.

5.2.1 TRANSLATION ALGORITHM

Requirement

Data is the fundamental resource upon whic the Target Data Routing function and its major interfaces operate. To ensure efficient interoperability, it is necessary tha. the data which flows across interfaces as well as internally within the targeting system be interchangeable, manageable and easy to use. As such, the requirement for a data translation capability in the Target Data Routing function stems from this basic need of interchangeability and simplicity in reporting and processing target data. More specifically, a data translation capability is required to be responsive to the following user needs:

- The need for interfacing nodes to continue to report data using the language and conventions prescribed by their own data and reporting systems.

- The need for the targeting analyst to interact with the automated Target Data Routing function using a relatively simple, easy to use English-like language.

- The need for data adaptability; i.e. a capability to easily add, delete, or change data base elements/codes, etc., consistent with changing reporting systems and data language conventions.

Translation Logic Operation

Figure 5.2-2 shows an overview of the translation logic operation Targeting intelligence messages are received from the four major interfacing nodes (i.e., SIGINT, SOTAS, etc.) in their own formats and languages.

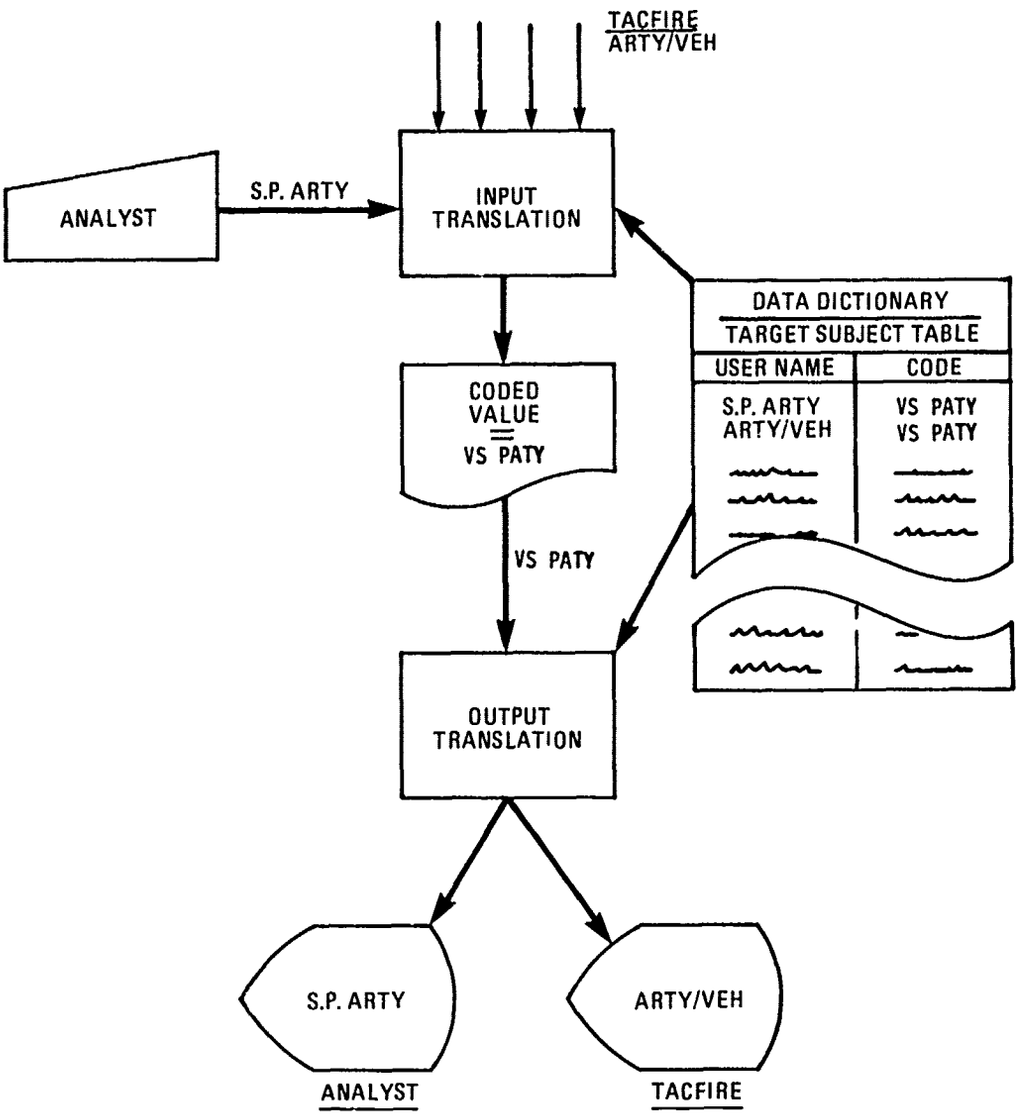


Figure 5.2-2. TRANSLATION ALGORITHM OPERATION.

Similarly, the targeting analyst may input data using his own English-like language conventions. Using the data dictionary and conversion tables, inputs are automatically converted by the input translation logic into codified form for data base storage. Likewise, for output, the data to be output is re-converted by the output translation logic from codified form into the language of the intended recipient of the output. The data dictionary/tables may similarly be changed to provide the degree of adaptability required.

Data Element Conversion

To operate the Target Data Routing function certain data elements must be reported or inferred (reference Section 5.2.2 for inference). Consistent with the concept of translation, the majority of these data elements will undergo conversion by the translation logic. The following are the data elements that are currently translated:

- Direct Reporting Flag
- Agency
- Method of Detection
- Report Reliability
- Friendly Unit Name
- Enemy Unit Name
- Unit Deployment Status
- Target Type or Subject
- Activity
- Target Mobility/Hardness Designators
- Target Category
- Target Characteristics
- Target Confirmation Status
- Target Engagement Status
- Known Air Defenses Around A Target
- Target Observability

5.2.2 Inference Algorithm

Requirement

The need for data inference became evident early in the analysis of the automated Target Data Routing function. It was discovered that certain data elements were critical to ensure valid and continuous operation of the function. Since the interfacing nodes/sources could not always realistically be expected to report these critical data elements, it was necessary to devise a data inference scheme based on predetermined relationships (i.e., a priori knowledge) of the data actually reported vs. that to be inferred. For example, the data element "Method of Detection" was considered critical to provide a measure of the reported target's validity. When not reported, "Method of Detection" could often be inferred from knowledge of the reporting source. As a simple example, if the reporting source was SOTAS, "Method of Detection" could be inferred as MTIR (Moving Target Indicator Radar). Likewise, it was determined that the other critical data elements could also be inferred from reported related data. The set of critical data elements that are currently inferred are listed as follows:

- Method of Detection

  Critical data element used to measure report and target reliability. Inferred when not reported.

- Target Category

  Critical data element used to aggregate target types/subjects into manageable categories. Inferred when not reported.

- o Target Worth

  Critical data element used to describe a target in terms of a numerical worth value. Always inferred.

- o Target Permanence

  The measure of a target's permanence in terms of time. Inferred when not reported.

- o Target Location Error

  In terms of meters. Inferred when not reported.

Rules of Inference

The rules of inference for each of the critical target data elements are summarized in Figure 5.2-3. These rules of inference will be used as the logic to automatically infer data values for those critical data element values not reported; (Target Worth, however, will always be inferred). As shown in Figure 5.2-3, each critical data element to be inferred is delineated in terms of its utility (need), the related data elements to be used as the basis for inference, and identification of the possible data values that can be inferred. To infer values for the method of detection and permanence data elements, only the message or report type is required. However, to infer values for target category, target worth and location error, multiple related data elements must be tested to arrive at a final inference value. By way of example, let us postulate an incoming target report from one of the interfacing nodes, which contains reported values for message type, target type, target characteristics, permanence and location error. The problem is to automatically infer method of detection, target category and target worth. The following

CRITICAL DATA ELEMENT TO BE INFERRED	DATA ELEMENT UTILITY	INFERENCE CRITERIA (BASIS OF INFERENCE)	INFERRED DATA VALUES
o Method of Detection	o Provides Measure of Target Reliability o Used in Correlation Algorithm	o Inferred when not reported* o Message Type (Report Source)	o MTIR o PHOTINT o INTERCEPT o COMINT DF o ELINT
o Target Category	o Used to Aggregate Target Types o Used in All Algorithms	o Inferred when not reported* o Message Type; Target Type; Target Characteristics; Target Ref. Number	o Concentration o Track Loss o CP/C2 o Supply/CS o Artillery o Met Radar o Rocket/Missile o Sam Radar/SAM o CF/GSR Radar o Track Origins o Assembly Area
o Target Worth	o Quantification of Target Value o Used in All Algorithms Except Association	o Always Inferred* o Message Type; Target Type; Quantity; Target Category; Target Characteristics and Enemy Unit Type	o Numerical Worth Values 10 thru 50
o Target Permanence	o Quantification of Permanence in Terms of Time o Used in Correlation and Assignment Algorithms	o Inferred when not reported* o Message Type	o Numerical Values in minutes
o Target Location Error	o Measure of Accuracy o Used in All Algorithms Except Association	o Inferred when not reported* o Message Type; Method of Detection	o Numerical Values in Meters

*When Possible

FIGURE 5.2-3. RULES OF INFERENCE SUMMARY

sequence applies:

1. To determine Method of Detection, only message type need be known. Since the message type has been reported, the inference table is searched to find an inferred method of detection value match for the message type reported. Once the match is made, the appropriate inferred method of detection value is assigned to that reported target.

2. To infer target category, multiple data elements are used as a basis (argument) for the inference table search; namely, message type, target type and target characteristics. Message type, target type and target characteristics are degrees of target delineation, starting with the grossest description (message type) and proceeding through the more detailed descriptions (i.e., target type and target characteristics in that order). Following this hierarchical principle of target description, the inference search for target category now becomes sequential. That is, each data element is tested for an inference match beginning with message type, and proceeding through target type and finally testing for a target characteristics/category match. The inferred target category value that will be assigned to the reported target will be the one which matches the most descriptive arguments, i.e., target characteristics, target type and message type in that order. Since, in this example all three arguments were reported, the inferred target category will be that which matches the reported target characteristics value. Similarly, if only message type and target type were reported, the inferred category would be that matching the next most descriptive argument (target type) and so on.

3. To infer target worth, a similar sequential inference search scheme is used as described above for inference of target category. When a match is made on any argument, the corresponding worth value is assigned. For multiple matches within any described target message, the highest worth number encountered is assigned.

5.2.3 Filter Algorithm

Requirement

The battlefield environment in which the Target Data Routing function must operate is characterized as a heavy-message traffic, data-rich environment. As such, the problem becomes one of managing voluminous amounts of messages and data such that workload is minimized while assuring that significant target data is presented in a timely manner for resolution and action. This problem creates the need for a report/data filter capability that is responsive to the target analyst's principal role of target management. More specifically, such a capability should:

- Provide a means to set and control report/data filter parameters commensurate with the battlefield situation.
- Provide a means to easily change filter parameters on a timely basis.
- Provide a means of directly routing significant target messages/data reports to the target analyst on a timely basis.

Filter Logic Operation

The primary purpose of the filter logic is to provide the targeting analyst with a capability through which incoming target messages can be controlled such that only significant target data is presented. The basis for the filter logic is the target presentation criteria. Target presentation criteria are selected target data elements which, for each type of incoming target report, provide varying combinations of target data filtering. Target presentation criteria include the following data elements:

- o Area
- o Age (i.e., Time Constraints)
- o Target Category
- o Target Worth
- o Target Location Error
- o Engagement Status
- o Target Confirmation Status
- o Target Reliability
- o Target Priority
- o Enemy Unit Identification
- o Key Words.

Figure 5.2-4 illustrates filter logic operation. Incoming target messages can be input from various sources and be of many types; mover reports from SOTAS, shooters from TACFIRE, emitters from SIGINT Sources and so on. In such an active and data-rich environment, the targeting analyst would soon become innundated with messages/data. To minimize this potential problem, the targeting analyst may use the filter logic capability. By establishing values for the target presentation criteria (e.g., area, worth, age, etc.) in desired combinations for each type of incoming report, the targeting analyst can limit (control) message action only to

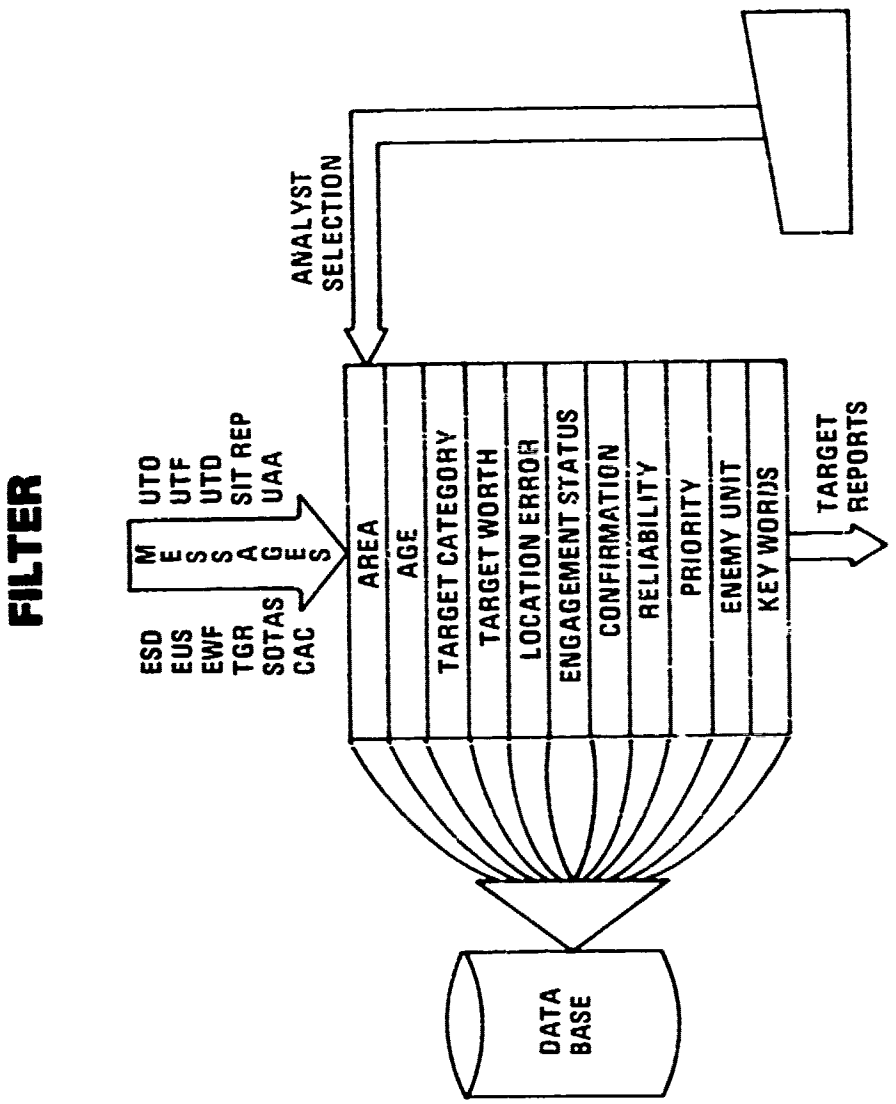


Figure 5.2-4 FILTER ALGORITHM OPERATION

those that are significant. Based on the target presentation criteria set by the targeting analyst, the filter logic can discriminate each message and select only those that pass the presentation criteria. Those messages that do not pass the criteria test will update the data base, storing that message data for reference and future use. Those incoming messages that satisfy the target presentation criteria will, in addition to updating the data base, also be directly routed to the targeting analyst in the form of an output report. As shown in Figure 5.2-4, the targeting analyst can control (change) the target presentation criteria on-line, providing an added dimension of capability.

In addition to the target presentation application described above, the filter logic is also used in the monitored area subfunction operation. As previously stated, the monitored area summary subfunction is used to determine if an incoming target message causes a predetermined threshold in a specified monitored area to be exceeded. As in the target presentation subfunction, the target analyst can set and control monitored area summary criteria (e.g., area, quantity. target origination/destination, etc.) for incoming mover, shooter and emitter type target messages. The filter logic tests each incoming message to ascertain if the data meets the analyst specified criteria by computing appropriate thresholds and testing to determine if that threshold has been exceeded. If a threshold is exceeded, a monitored area summary report will be directly routed to the target analyst.

Filter Logic Rules

A sample set of filter logic rules for target presentation are shown in Figure 5.2-5. The matrix shown, relates target message types to the target presentation criteria, which are defined as selected target data elements. The target presentation criteria are relationally connected by logical "ands" and "ors" to form a specific array and their values.

REPORT SOURCE	REPORT DESCRIPTION	REPORT TYPE	LOGICALLY "ANDED" CRITERIA								ENEMY UNIT TYPE
			AGE (MINUTES)	AREA	TARGET CATE-GORY	TARGET WORTH	LOCA-TION ERROR	ENGAGE STATUS	CONFIRM STATUS	OR	
TACFIRE	SHOOTER REPORT	DA4A	X	X	X	X	X	X	X		
TACFIRE	• NON GSR ENEMY ACTIVITY/CONCENTRATION	DA4B	X	X	X	X	X	X			
TACFIRE	• GSR ENEMY ACTIVITY/CONCENTRATION	DA4C	X	X	X	X	X	X			
SOTAS	• TRACK REPORT (HIGH INTEREST)	SO2	X	X	X	X	X				
SOTAS	• TRACK LOSS REPORT	SO3	X	X	X	X	X				
SOTAS	• SPECIFIC TRACK REPORT	SO4	X	X	X	X	X				
SOTAS	• TRACK LOSS REPORT (SPECIFIC TRACK)	SO5	X	X	X	X	X				
SOTAS	• INFERRED CP/ASSEMBLY AREA, POL ETC	SO6	X	X	X	X	X				
DIV/SIGINT	• ENEMY ACTIVITY/CONCENT EMITTER RPT	CA2	X	X	X	X	X				
DIV/SIGINT	• ENEMY CP/ARTY EMITTER REPORT	CA3	X	X	X	X	X				
DIV/SIGINT	• ENEMY RADAR EMITTER REPORT	CA4	X	X	X	X	X				
DIV/SIGINT	• ENEMY SUPPLY/DEPOT/CS SIGINT REPORT	CA5	X	X	X	X	X				
CORPS	• ENEMY FORCE CONCENTRATION PHOTINT RPT	CO4A	X	X	X	X	X				
CORPS	• ENEMY FORCE CONCENTRATION SIGINT REPORT	CO4B	X	X	X	X	X				
CORPS	• ENEMY CP/ARTY PHOTINT REPORT	CO5A	X	X	X	X	X				
CORPS	• ENEMY CP/ARTY EMITTER REPORT	CO5C	X	X	X	X	X				
CORPS	• ENEMY RADAR/MISSILE PHOTINT REPORT	CO6A	X	X	X	X	X				
CORPS	• ENEMY RADAR SIGINT REPORT	CO6B	X	X	X	X	X				
CORPS	• ENEMY SUPPLY/DEPOT/CS PHOTINT REPORT	CO7A	X	X	X	X	X				
CORPS	• ENEMY SUPPLY/DEPOT/CS SIGINT REPORT	CO7B	X	X	X	X	X				
TROOPS IN CONTACT	• ENEMY SITUATION DATA	ESDA	X	X	X	X	X				X

FIGURE 5.2-5. FILTER LOGIC RULES

represented by "X's". The actual criteria values (X's) would be specified by the targeting analyst to form conbinations of logical arrays. Using these filter logic rules, the targeting analyst may tailor the target presentation criteria for incoming messages and thereby selectively control target data presentation.

5.2.4 Correlation Algorithm

Requirement

As previously stated, the primary objective of the Target Data Routing function is to enhance the DTOC process of real time execution of weapons and forces. As such, the Target Data Routing function must have the means to recommend those targets which, in and of themselves, are of high enough value and priority to warrant immediate strike action. Thus, the requirement becomes twofold:

1. The need for an automated capability that can assess the value and priority of any incoming target; and

2. The need to expeditiously route high value target data and its associated fire mission request to the appropriate weapon system for immediate strike action.

Correlation Logic Operation

The correlation logic is the heart of the Target Data Routing function. Its primary purpose is to automatically assess incoming target data to determine immediate strike value (high value) of that target and to expeditiously route such targets directly to the executing weapon system in the form of fire mission requests.

Figure 5.2-6 shows an overview of the correlation logic operation. The three major factors that influence a measure of a target's value are: a quantified measure of target worth; its accuracy (location error), and its permanence. As such, the basic objective of the correlation logic is to assess these three factors by correlating selected attributes of reported (or inferred) data with related data stored in the data base within given time and distance constraints. As shown in the example in Figure 5.2-6, each incoming target message is tested in terms of its critical data attributes, namely target category, worth, method of detection, location error and permanence. This is accomplished for each message type through a series of 28 possible logical statements (queries) or correlation rules (listed in the subsequent subsection in Figure 5.2-7). Once tested, these reported or inferred target attributes now provide the basis or argument for the logic to further search the data base for correlating or corroborating information on that target, within the time (age) and distance constraints provided in the correlation test tables. If the target is assessed as high value, it is assigned to a weapon (reference subsection 5.2.6) and, after target analyst review of the target presentation summary report, can be directly routed to the appropriate weapon system in the form of a fire mission request.

Using the example shown in Figure 5.2-6, a SOTAS mover report is received by the Target Data Routing function. In this case the SOTAS message is reporting a mover track loss which was inferred to be of high worth since a track loss implies mover stoppage, and therefore a possible assembly area. The track loss message was further tested to determine what additional corroborating information was required to assess that target's value. In this example, it was target category (i.e., what target category did the track loss represent), location and location error (accuracy). The objective of or the logic, at this point, was to

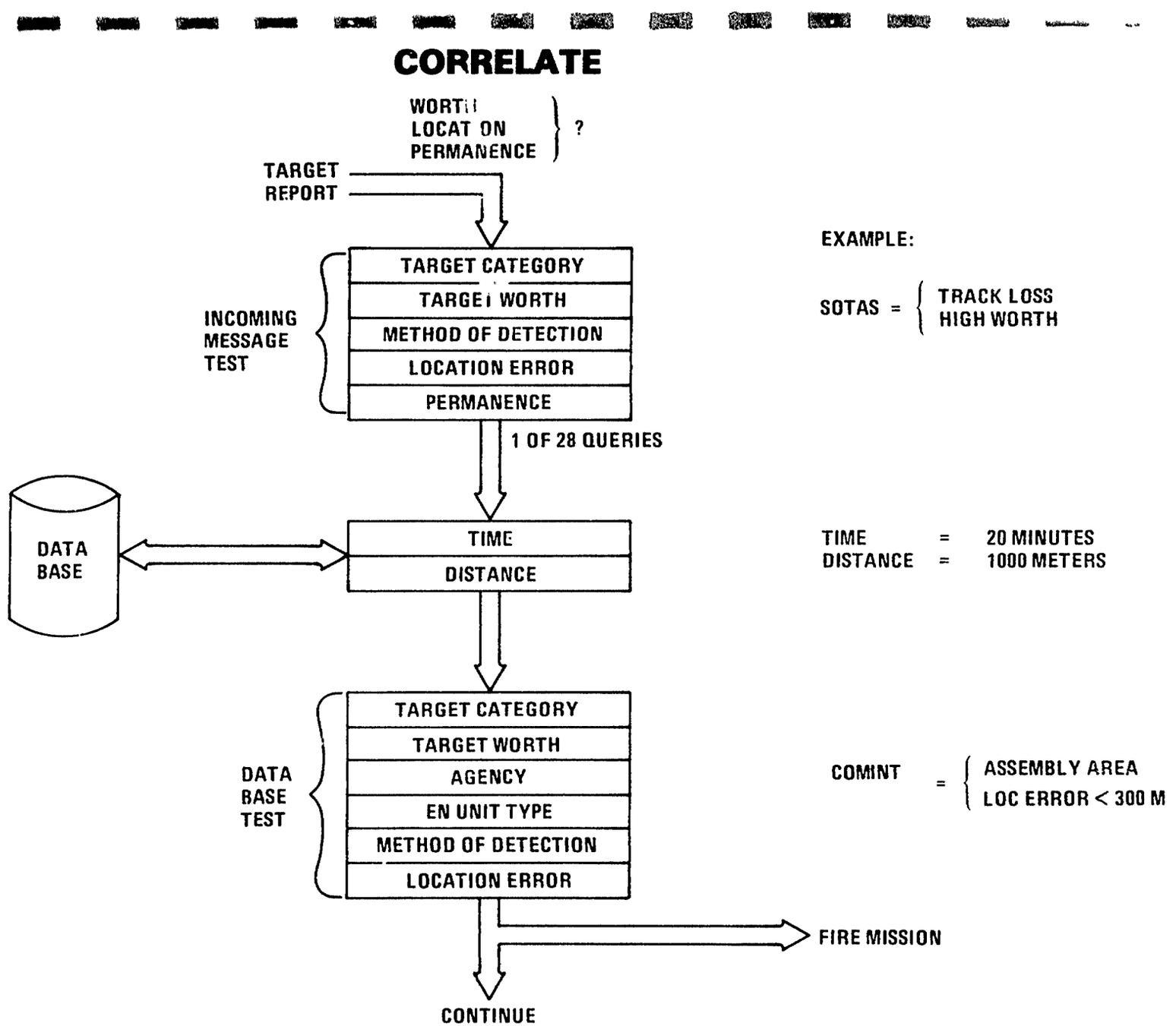


Figure 5.2-6 CORRELATION LOGIC OPERATION

search the data base for the required corroborating information within the given time (20 minutes) and distance constraints (1,000 meters). The data base was searched to find related data element values that matched the argument(i.e., corroborating data element requirements) according to the correlation rules. In this example, the resulting information corroborated the fact that the reported SOTAS track loss did represent an assembly area as detected by a COMMINT DF report within the last 20 minutes and with an acceptable location error. Based on this knowledge, the assembly area would be targeted and a fire mission request generated directly to the assigned weapon system.

Correlation Logic Rules

The table in Figure 5.2-7 shows the rules for the correlation logic. The table organized in matrix form describes the target value tests for each type of target message. Target value tests are shown in terms of the incoming message test, time and distance test, and the data base test to provide correlative or corroborating target information. Within each category of test, the criteria (values) for each critical data element are shown. all columns are logically "anded" while multiple values within a column are logically "or'ed" There are 28 different logical tests.

CORRELATION SITUATION/ (CORRELATION PAIRS)	MESSAGE TYPES TO BE TESTED	INCOMING MESSAGE TEST - LOGICALLY "ANDED" CRITERIA - TARGET CATEGORY	METHOD OF DETECTION	TGT WORTH	LOC ERROR	TFIRE ADDRESSABLE	PERM		LOC CONSTRAINT		TIME CONSTRAINT		DATA BASE CORRELATION TEST - LOGICALLY "ANDED" CRITERIA AGENCY	TARGET CATEGORY	METHOD OF DETECTION	TGT WORTH	LOC ERROR	ENEMY UNIT TYPE
• MOVEMENT THROUGH A SPECIFIC TARGETED LOCATION	DA4C (GSR) S04 (SPECIFIC TRACK) S02 (TRACK)	ENEMY CONCENTRATION	MTIR	1					1									
• OCCUPIED ASSEMBLY OR FORCE CONCENTRATION AREA (MOVER/PHOTINT)	S01 S05 (TRACK LOSS)	TRACK LOSS	MTIR	1					2		1			ASSEMBLY AREA	PHOTINT			
• OCCUPIED ASSEMBLY OR FORCE CONCENTRATION AREA (MOVER/SIGINT)	S03 S05 (TRACK LOSS)	TRACK LOSS	MTIR	1					2		1			ASSEMBLY AREA	INTERCEPT OR COMMINT OF		1	
								AND		AND		AND						
• OCCUPIED ASSEMBLY OR FORCE CONCENTRATION AREA (PHOTINT MOVER)	C04A (PHOTINT)	ASSEMBLY AREA	PHOTINT						2		1			TRACK LOSS	MTIR	1		
• OCCUPIED ASSEMBLY OR FORCE CONCENTRATION AREA (INFERRED MOVER/MOVER ACTIVITY)	S06 (INFERRED ASSEMBLY AREA)	ASSEMBLY AREA	MTIR						2		1			TRACK LOSS	MTIR	2		
• LPOREZ (SIGTAS SIGINT)	S06 (INFERRED FP)	COMMINT OF	MTIR						2		1			LPOREZ	INTERCEPT OR COMMINT OF	1	1	
• SUPPLY COMBAT (SERVICE) (SIGTAS SIGINT)	S06 (INFERRED SUPPLY OR CS AREA)	FLINT	MTIR						2		1			SUPPLY COMBAT SERVICES	INTERCEPT OR COMMINT OF			

LEGEND

LOCATION ERROR

1) EQUAL TO OR LESS THAN A SPECIFIED NUMBER OF METERS

JOINT LOCATION CONSTRAINT

1) INCOMING MGR IS WITHIN A SPECIFIED NAMED POLYGON

2) (X ± R, Y ± R) WHERE R IS A SPECIFIED NUMBER TO BE DETERMINED FOR EACH CASE IN PLXXX YYY THE LEAST UNIT OF X Y OR R IS 100 M

TARGET WORTH

1) EQUAL TO OR A SPECIFIED WORTH NUMBER

2) FOR ALL RECORDS THAT QUALIFY ON ALL OTHER SPECIFIED PARAMETERS THE SUM OF THE QTY FIELD MUST EXCEED A SPECIFIED THRESHOLD

JOINT TIME CONSTRAINT

1) (CURRENT TIME − CURRENT TIME) ≤ T WHERE T IS A SPECIFIED NUMBER OF MINUTES

PERMANENCE

1) (CURRENT TIME + PERMANENCE MINUS (EVENT TIME) ≥ A SPECIFIED THRESHOLD IN MINUTES

FIGURE 5 2 7 CORRELATION LOGIC RULES (SHEET 1 OF 3)

CORRELATION SITUATION/ (CORRELATION PAIRS)	MESSAGE TYPES TO BE TESTED	INCOMING MESSAGE TEST – LOGICALLY "ANDED" CRITERIA – TARGET CATEGORY	METHOD OF DETECTION	TGT WORTH	LOC ERROR	TFIRE ADDRESSABLE	PERM		LOC CONSTRAINT		TIME CONSTRAINT		DATA BASE CORRELATION TEST LOGICALLY "ANDED" CRITERIA AGENCY	TARGET CATEGORY	METHOD OF DETECTION	TGT WORTH	LOC ERROR	ENEMY UNIT TYPE
• OCCUPIED ASSEMBLY OR FORCE CONCENTRATION AREA (SIGINT MOVER)	CAT COMB SIGINT	ASSEMBLY AREA	INTERCEPT OR COMINT DF		1				2		1			TRACK LOSS	MTIR	1		
• SHOOTER LOCATION TUBE ARTILLERY (TACFIRE SUSPECT SHOOTER)	DASA (TACFIRE SUSPECT SHOOTER)	ARTILLERY				YES			2		1			ARTILLERY	PHOTINT			
• SHOOTER LOCATION TUBE ARTILLERY (TACFIRE SIGINT	DASA (TACFIRE SUSPECT SHOOTER)	ARTILLERY				YES			2		1			MET RADAR	ELINT			
• SHOOTER LOCATION TUBE ARTILLERY PHOTINT TACFIRE	DASA (PHOTINT)	ARTILLERY	PHOTINT			YES			2		1		DIVARTY	ARTILLERY				
								AND		AND		AND						
• SHOOTER LOCATION TUBE ARTILLERY PHOTINT SIGINT	DASA PHOTINT	ARTILLERY	PHOTINT			YES			2		1			MET RADAR	ELINT			
• [illegible] PHOTINT SIGINT	DASA PHOTINT	CP CZ	PHOTINT						2		1			CP CZ	INTERCEPT OR COMINT DF			
• SHOOTER LOCATION TUBE ARTILLERY SIGINT TACFIRE	CAT COMB SIGINT	MET RADAR	ELINT								1		DIVARTY	ARTILLERY				
• SHOOTER LOCATION TUBE ARTILLERY SIGINT PHOTINT	CAT COMB SIGINT	MET RADAR	ELINT						2		1			ARTILLERY	PHOTINT			
• ROCKET SSM SIGINT PHOTINT	CAT COMB SIGINT	ROCKET MISSILE	INTERCEPT	1					2		1			ROCKET MISSILE	PHOTINT			
• CP CZ SIGINT PHOTINT	CAT COMB SIGINT	CP CZ	INTERCEPT OR COMINT DF	1					2		1			CP CZ	PHOTINT			

FIGURE 5.2.7 CORRELATION LOGIC RULES (SHEET 2 OF 3)

CORRELATION SITUATION/ (CORRELATION PAIRS)	MESSAGE TYPES TO BE TESTED	INCOMING MESSAGE TEST LOGICALLY "ANDED" CRITERIA – TARGET CATEGORY	METHOD OF DETECTION	TGT WORTH	LOC ERROR	TFIRE ADDRESSABLE	PERM		LOC CONSTRAINT		TIME CONSTRAINT		DATA BASE CORRELATION TEST LOGICALLY "ANDED" CRITERIA – AGENCY	TARGET CATEGORY	METHOD OF DETECTION	TGT WORTH	LOC ERROR	ENEMY UNIT TYPE
• CP C2 (SIGINT WITHIN KNOWN ENEMY UNIT AREA)	CA3 COSB (SIGINT)	CP C2	INTERCEPT OR COMINT OI	1					1									
• CP C2 (SIGINT WITH ACCURACY)	CA3 COSB (SIGINT)	CP C2	INTERCEPT	1	1													
• CP C2 (SIGINT SOTAS)	CA3 COSB (SIGINT)	CP C2	INTERCEPT OR COMMINT OI	1	1				2		1			CP C2	MTIR			
• AIR DEFENSE SITE SIGINT WITH ACCURACY	CA3 COSB (SIGINT)	SAM RADAR SAM	ELINT		1	YES												
• AIR DEFENSE SITE SIGINT PHOTINT	CA3 COSB (SIGINT)	SAM RADAR SAM	ELINT			YES			2		1			SAM RADAR SAM	PHOTINT			
• COUNTERFIRE OR GSR SITE (SIGINT WITH ACCURACY)	CA3 COSB (SIGINT)	COUNTER FIRE OR GSR RADAR	ELINT		1	YES												
• ROCKET OR SSM SIGINT WITHIN KNOWN ENEMY UNIT AREA	CA3 COSB (SIGINT)	MET RADAR	ELINT					AND	2	AND	1	AND						ERDL
• AIR DEFENSE SITE PHOTINT SIGINT	COSA PHOTINT	SAM RADAR SAM	PHOTINT			YES			2		1			SAM RADAR SAM	PHOTINT OR ELINT			
• ROCKET OR SSM PHOTINT SIGINT	COSA PHOTINT	ROCKET MISSILE							2		1			ROCKET MISSILE	INTERCEPT	1		
• SUPPLY CS SIGINT WITH MOVEMENT ACTIVITY	CA3 COSB (SIGINT)	SUPPLY OR CS	INTERCEPT OR COMMINT OI						2		1			TRACK LOSS OR TRACK ORIGINATION	MTIR	2		
• SUPPLY CS PHOTINT WITH INDICATE PERMANENCE	COSA PHOTINT	SUPPLY OR CS	PHOTINT	1			1											

FIGURE 5-27 CORRELATION LOGIC RULES (SHEET 3 OF 3)

5.2.5 Association Algorithm

Requirement

As previously stated, the battlefield targeting environment is a data-rich environment in which the targeting analyst is the principal manager of the targeting information resource. As such, the targeting analyst must have the capability to exploit the relationship of the varied target data that flows across and through DTOC interfaces. This data exploitation capability must be such that target data relevance and significance can be derived from the voluminous amounts available. Therefore, there is a requirement to provide an automated capability through which the targeting analyst may associate and relate incoming target data with that already reported and stored in the data base to increase the potential information value of targets.

Association Logic Operation

The association algorithm is a corollary of the correlation capability in that it relates incoming target message data with previously reported target data to enhance the information value of reported targets.

Figure 5.2-8 shows an overview of the association logic operation. After being processed through the correlation logic for target value assessment, each incoming target message is further tested by the association logic. The association logic operates via a set of 18 logic statements (rules, described in Figure 5.2-9 in the subsequent subsection). Based on these rules, the target category for each message is tested to determine the type of related target data required. Based on the related data required and the specified time and distance constraints, the association logic searches the data base for the appropriate data matches. For each match (i.e., for each related target found in the data base),

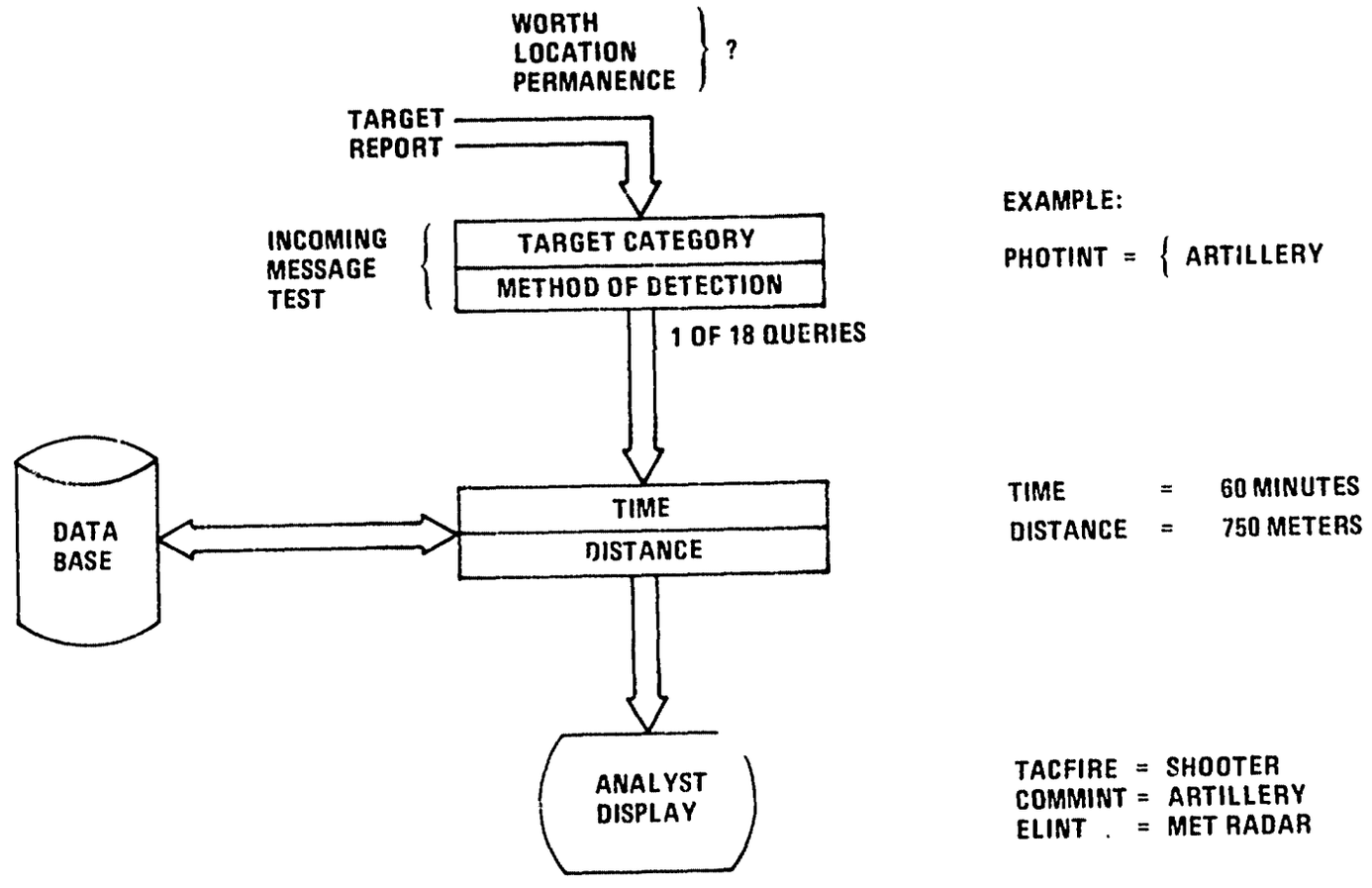


Figure 5.2-8 ASSOCIATION LOGIC OPERATION

the following data is retrieved for output: target category, quantity, method of detection, location, time detected, and target reference number. The resulting information is then formatted as part of the target presentation summary output report. The output report is then directly routed to the targeting analyst and to the assigned weapon system if the incoming target message was previously determined to be of immediate strike value. In the event that the resulting output is not of high value and therefore not directly routed to the assigned weapon system, the targeting analyst will have the capability to transmit the output to the appropriate interfacing mode for information purposes.

Association Logic Rules

Figure 5.2-9 shows an example of the rules for the association logic. As shown, target data is associated based primarily on incoming message type, related message type target category, and time and distance constraints. There are 18 different logic statements that comprise the association logic rules.

5.2.6 Assignment Algorithm

Requirement

To expedite direct routing of high value target data and fire mission requests to the targeting analyst and appropriate weapon system, the need exists for a capability to grossly assign targets to weapons. Furthermore, such a target assignment capability must adequately reflect the commander's rules of engagement consistent with current battlefield situations. As such, the requirement exists for:

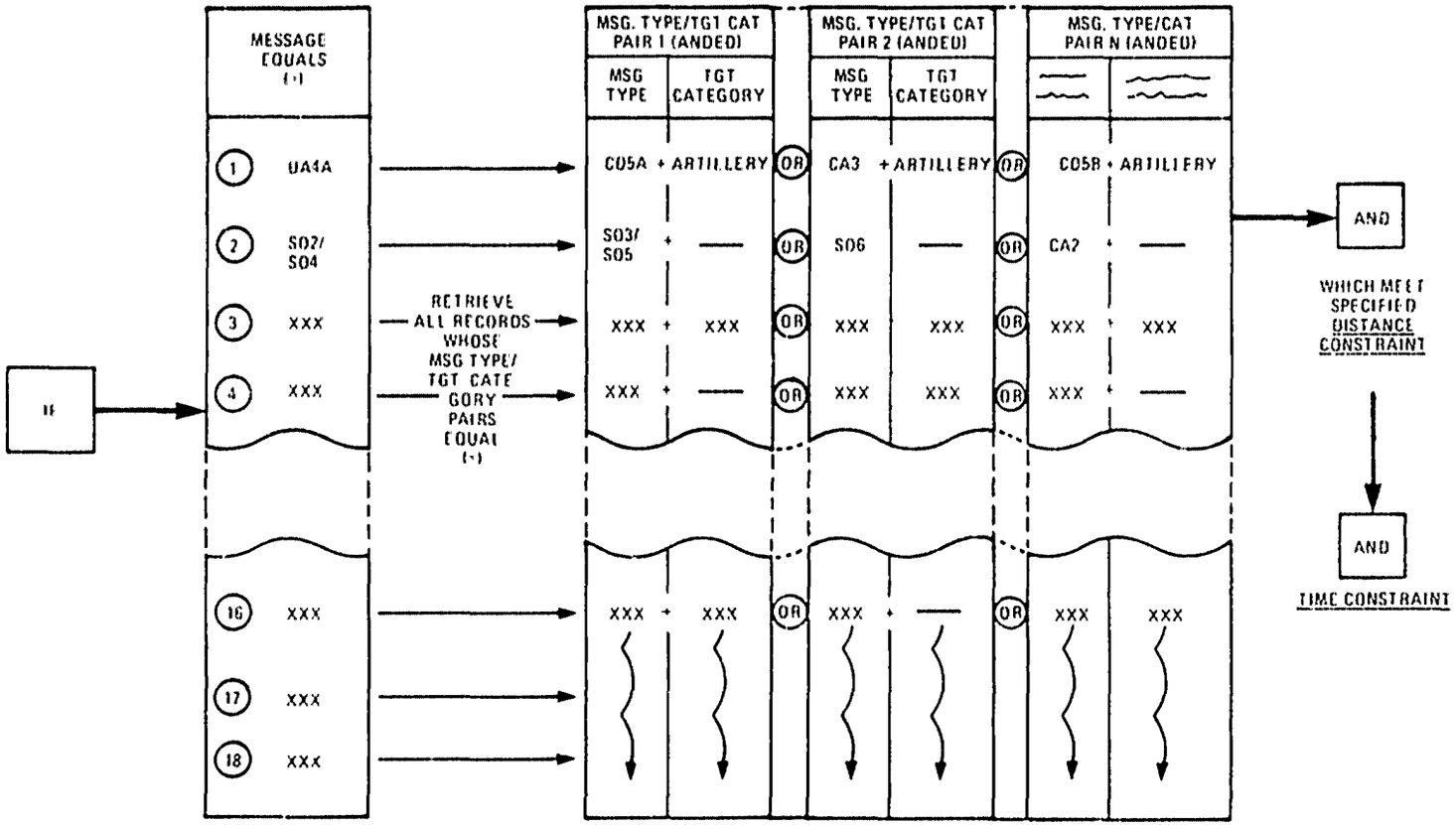


Figure 5.2-9. EXAMPLE ASSOCIATION LOGIC RULES.

- o An automated capability to assign a target to a specific weapon system based on the commander's current rules of engagement. Such a capability must operate closely with the target high/low value tests (i.e., correlation and association logic).

- o A capability by which the targeting analyst may easily change the criteria for target assignment based on changing rules of engagement.

Assignment Logic

In support of direct target data routing, the assignment logic will provide the automated capability to assign targets to specific weapons based on the commander's current rules of engagement. Figure 5.2-10 shows an overview of the assignment logic operation. Essentially, the assignment logic operates by relating selected reported and/or inferred target data values with predetermined rules of engagement criteria stored in the data base to determine weapon restrictions and assignments. The principal target data parameters used are: area, target category, target worth, and permanence. The rules of engagement parameters are primarily area oriented; i.e., restriction areas (no fire and coordinated fire areas) and weapon assignment areas (TACFIRE, Attack Helo, and TACAIR zones of fire). For each incoming message, whose reported target has been processed through the target presentation logic (i.e., filtering, correlation, and association), and requires assignment, that target's location is tested to determine what engagement areas it falls into. Next, the values of the reported target (i.e., worth, location error, etc.) are tested against the predetermined values (criteria) stored in the data base. Based on these tests, the appropriate weapon restrictions and assignments are determined. The resulting restrictions/assignments

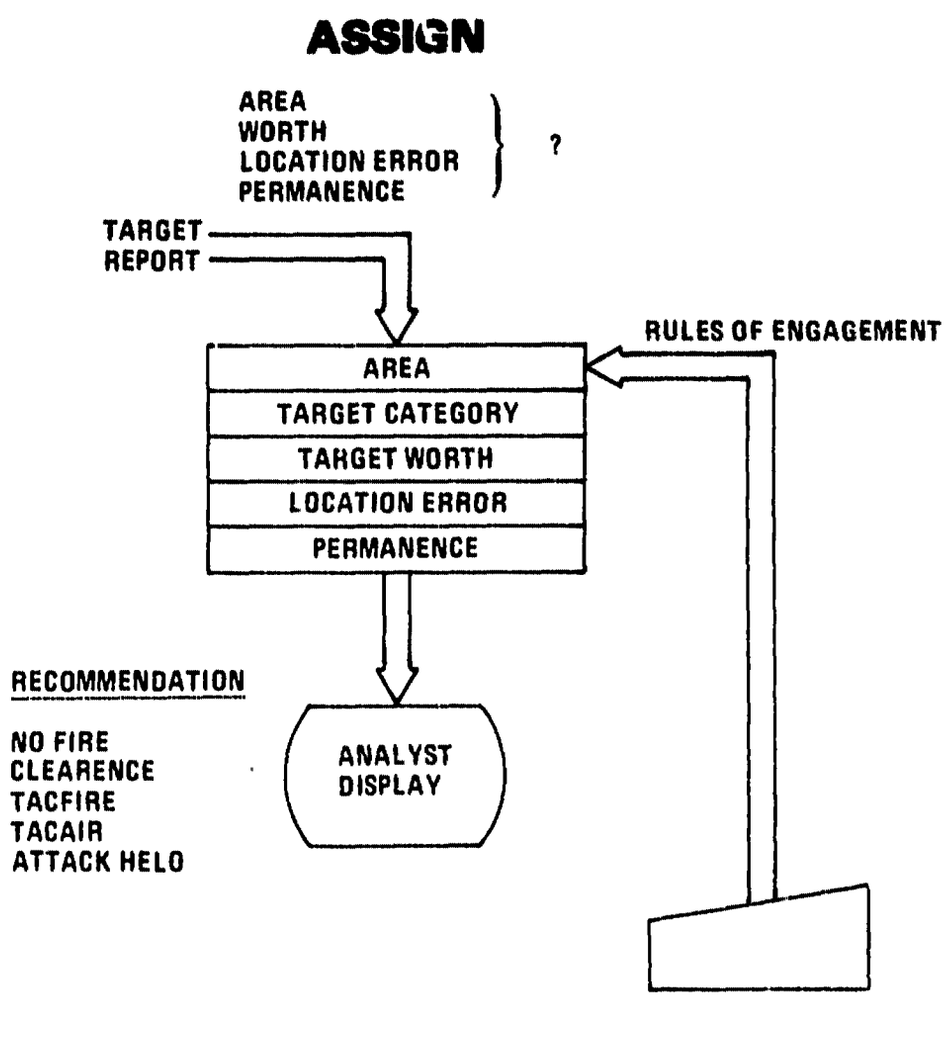


Figure 5.2-10 ASSIGNMENT LOGIC OPERATION

are incorporated in the target presentation summary output report and routed directly to the targeting analyst and the appropriate weapon system if the target is of high value.

In addition, the targeting analyst may control (change) the rules of engagement criteria through on-line interaction with the system. Such a capability facilitates easy adjustment of assignment criteria when warranted by changing rules of engagement.

Assignment Logic Rules

Figure 5.2-11 shows an example of the target assignment logic rules. As shown, the sample rules are organized in matrix form relating engagement areas, criteria for engagement (i.e., selected data element parameters) and weapon assignment/restriction criteria.

IF THE INCOMING REPORT LOCATION IS WITHIN AREA(S)	TARGET CATEGORIES (LOGICALLY "OR'D")					RELAT OPER	TARGET WORTH (LOGICALLY "OR'D")					NOT SUSPECT	LOC ERROR	RELAT OPER	PERM	THEN WEAPON RESTRICTION/ ASSIGNMENT IS
	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5		W1	W2	W3	W4	W5					
• WITHIN DIVISION NO FIRE AREA																• NO FIRE AREA
• NOT WITHIN DIVISION NO FIRE AREA BUT WITHIN AREAS RESTRICTED TO COORDINATED FIRE																• COORDINATED FIRE AREA
• NOT WITHIN EITHER DIV NO FIRE OR RESTRICTED COORD FIRE AREA BUT WITHIN TARGETED LOCATION AREA																• TACFIRE
• NOT WITHIN EITHER DIVISION NO FIRE OR COORDINATED FIRE AREAS BUT WITHIN TACFIRE ZOF OR HELO STRIKE AREA OR TACAIR STRIKE AREA	ASSEMBLY AREA	CONCEN TRATION	TRACK ORIGIN	TRACK LOSS		AND	50						320	OR	005	• ATTACK HELO
• SAME CONDITION AS ABOVE													320	AND	005	• TACFIRE
• SAME CONDITION AS ABOVE	ARTILLERY	SAM RADAR/ SAM	CP/C2	SUPPLY/ C/S	ROCKET/ MISSILE	AND	50					NO	320	OR	005	• TACAIR
• NOT WITHIN DIV NO FIRE OR COORD FIRE AREAS OR TACAIR STRIKE AREA BUT IS WITHIN TACFIRE ZOF OR HELO STRIKE AREA													320	AND	005	• TACFIRE
• SAME CONDITION AS ABOVE							50						320	OR	005	• ATTACK HELO
• NOT WITHIN DIV NO FIRE OR COORD FIRE AREAS OR HELO STRIKE AREA BUT WITHIN TACFIRE ZOF AND TAC AIR STRIKE AREA													320	AND	005	• TACFIRE
• SAME CONDITION AS ABOVE							50					NO	320	OR	005	• TACAIR

Figure 5.2-11. TARGET ASSIGNMENT LOGIC RULES (SHEET 1 OF 2).

IF THE INCOMING REPORT LOCATION IS WITHIN AREA(S)	TARGET CATEGORIES (LOGICALLY "OR'D")					RELAT OPER	TARGET WORTH (LOGICALLY "OR'D")					NOT SUSPECT	LOC ERROR	RELAT OPER	PERM	THEN WEAPON RESTRICTION/ ASSIGNMENT IS
	CAT 1	CAT 2	CAT 3	CAT 4	CAT 5		W1	W2	W3	W4	W5					
• NOT WITHIN DIV NO FIRE OR COORD FIRE AREAS OR HELO OR TACAIR STRIKE AREAS BUT WITHIN TACFIRE ZOF													320	AND	005	• TACFIRE
• NOT WITHIN DIV NO FIRE OR COORD FIRE AREAS OR TACFIRE ZOF BUT WITHIN HELO AND TACAIR STRIKE AREAS	ASSEMBLY	CONCEN TRATION	TRACK LOSS	TRACK		AND	30	50								• ATTACK HELO
• SAME CONDITION AS ABOVE	ARTILLERY	SAM RA DAR/SAM	CP/C2	SUPPLY/ CS	RE.CKET/ MI SILE	AND	50					NO				• TACAIR
• NOT WITHIN DIV NO FIRE OR COORD FIRE AREAS NOR TACFIRE ZOF OR TACAIR STRIKE AREA BUT WITHIN HELO STRIKE AREA							30	50								• ATTACK HELO
• NOT WITHIN DIV NO FIRE OR COORD FIRE AREAS NOR TACFIRE ZOF OR HELO STRIKE AREA BUT WITHIN TACAIR STRIKE AREA							10	50				NO				• TACAIR

Figure 5.2-11. TARGET ASSIGNMENT LOGIC RULES (SHEET 2 OF 2).

5.3 TARGET DATA ROUTING FEATURES

In addition to the Target Data Routing algorithms described in the previous sections, there are various other features that were designed into the overall system. These features were included to be particularly responsive to the targeting analyst's need for:

- flexibility in interacting with the major interfacing nodes (e.g., TACFIRE)
- flexibility in interacting with the targeting data base on a timely basis
- flexibility in interacting with the functional logic rules and parameters (criteria)
- flexibility in receiving timely outputs consistent with the real time nature of the target data routing function.

As such, these features have been characterized as:

- Data Base Interaction Features
- Output Capability Features
- Man-Machine Interaction Features.

Each is briefly discussed in the following subsections.

5.3.1 Data Base Interaction Features

The targeting analyst and DTOC Staff can interact wtih the targeting data base through:

- o An on-line query capability
- o An off-line batch processing capability.

The query capability is a simple to use English-like language through which the analyst may logically interact with the data base directly through a CRT terminal. This query language has a full repetoire of logical conventions through which query statements may be constructed and communicated to the data base in a timely fashion. In constructing queries, the analyst is aided by simple instructions which appear on the CRT screen. These cues contain information which assist in selecting the target data elements to be manipulated and the associated logical operators in terms of simple boolean relationships. In addition, this capability provides a means to specify output reports in various formats. The utility of the query capability is to retrieve on-demand or ad-hoc target information and to specify SRI's.

In addition to the on-line query capability, a batch processing capability exists. Batch processing is most useful when dealing with manipulation of large amounts of data such as overall initialization of the data base and parameter matrices.

5.3.2 Output Capability Features

As previously described, the principal output of the target data routing function is the target presentation summary. This output report is routed directly to the targeting analyst's terminal as a result of an incoming target message triggering target presentation criteria.

i.e., filtering), high value target tests (correlation), related targets tests (association), and rules of engagement criteria (assignment). The data contained in the target presentation summary is primarily tabular in nature formatted in easy to read, non-cryptic English language. To provide added perspective, a collateral target graphics presentation may be simultaneously output when a target presentation summary appears on the analyst's CRT screen. The target graphics presentation is a repre- [illegible]ion of the tabular data contained in the target presentation [illegible]ary portrayed against a geographic background (map). It has appropriate symbol and color capability as well as scaling capability to enlarge any selected portion of the geographic area presented. An example of the target presentation collateral displays are shown in Figures 5.3-1 and 5.3-2.

In addition to the collateral output displays, the output features include the capability for the system to directly route (transfer) any of the target data directly to an interface (e.g., TACFIRE). This is in addition to the capability of direct routing of target mission requests in fire mission request formate to TACFIRE.

5.3.3 Man-Machine Interaction Features

As previously described, the targeting analyst can control the algorithm rules and criteria by changing parameters to be consistent with the battlefield targeting environment. To accomplish this task, interactive procedural logic has been added. This capability permits the targeting analyst to manipulate logic parameters on line through a series of procedural selection cues which are output on the CRT screen. Each cue is appropriately identified and contains instructions to assist the analyst through the procedural chain. Again, the instructions and data contained in these cues is in non-cryptic, English-like language. Selected parameters may be controlled (i.e., added, deleted, or changed) on-line via an input typewriter and light pen. The use

TARGET DATA PRESENTATION

```
TARGET:        XXXXXXXXXXXXXXX    AGENCY:   XXXXXXX    LOC:   XXXXXXXX    TIME:   XXXXXXXX

RELATED TARGETS:                  QTY:     METHOD:        LOCATION:      TIME:          REFERENCE:
          XXXXXXXXXXXXXXXXXXXX    XXXXX    XXXXXXXX       XXXXXXXX       XXXXXXXX       XXXXXX
****      X------------------X    X---X    X------X       X------X       X------X       X----X      **
          X------------------X    X---X    X------X       X------X       X------X       X----X
          X------------------X    X---X    X------X       X------X       X------X       X----X
          XXXXXXXXXXXXXXXXXXXX    XXXXX    XXXXXXXX       XXXXXXXX       XXXXXXXX       XXXXXX

**** F RE MISSION RECOMMENDED     ****     ****     ****    FIRE MISSION RECOMMENDED              ****

ASSIGNMENT:                       TARGET WITHIN ARTY ZONE:  HELO ZONE:   TACAIR ZONE:
          XXXXXXXXXXXXXXXXXXXX                       XXX        XXX            XXX

TARGET MESSAGE:   XXXX
  SUBJECT:   XXXXXXXXXXXXXXXXXXXX    CHARS:   XXXXXXXXXXXXXXXXXXXX    LOCATION:   XXXXXXXX
    QTY:   XXXXX   DIR: XXX    VEL:   XXX   PERM: XXXXX    LOCERR:   XXXX    TIME:   XXXXXXXX
      TARG NO:   XXXXXX                AGENCY:   XXXXXXXXXX          METHOD:   XXXXXXXXXXXXXXXXXXXX
  REMARKS:  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Figure 5.3-1 TARGET PRESENTATION SUMMARY DISPLAY (ALPHANUMERIC)

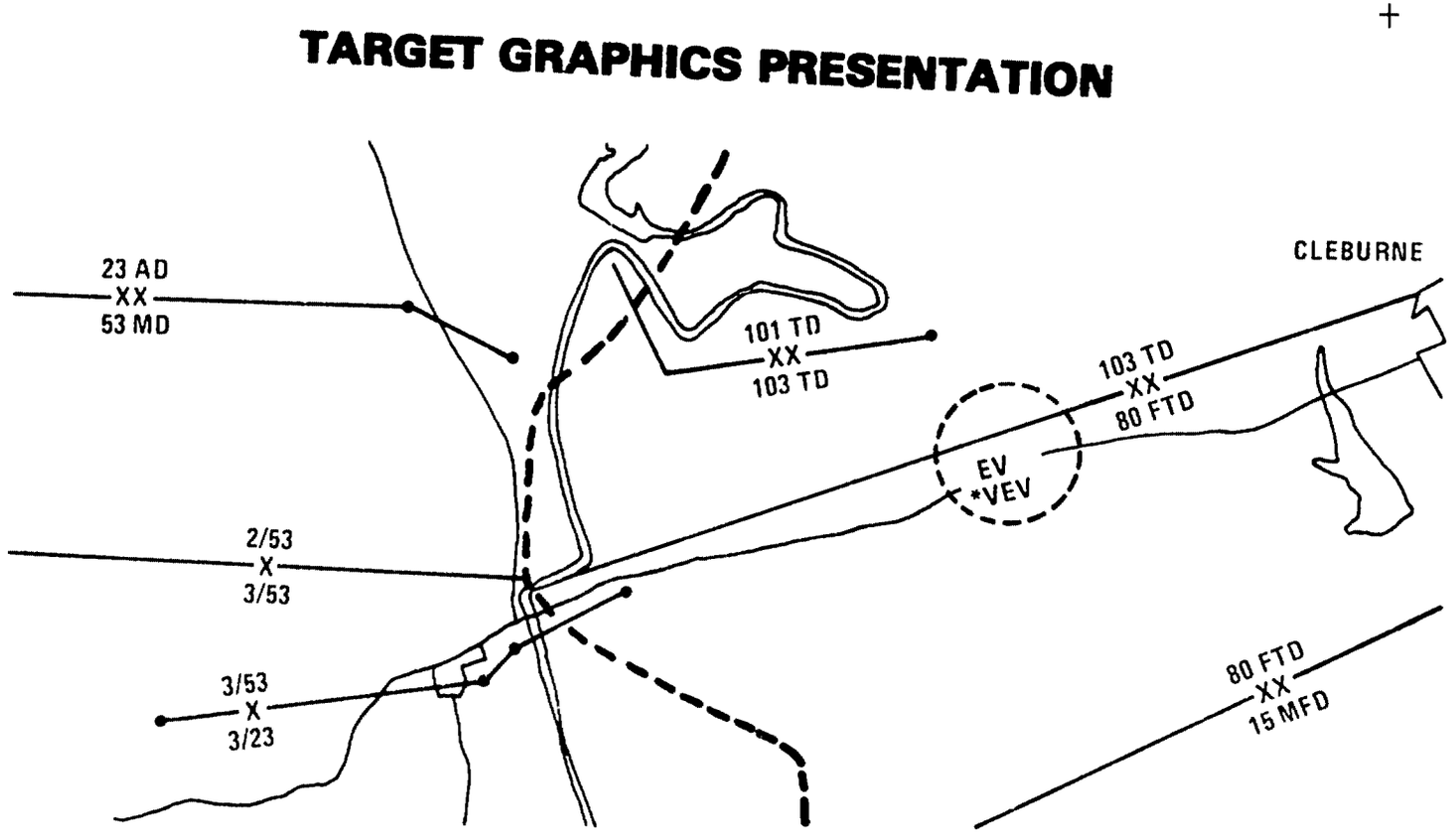


Figure 5.3-2 TARGET PRESENTATION SUMMARY COLLATERAL GRAPHICS DISPLAY

of these procedural cues provides the following capabilities:

- The capability to add, delete or change target presentation area names and their associated geometry (MGR's).

- The capability to add, delete or change monitored named area geometry in terms of area name, circle center (MGR) and radius (meters).

- The capability to modify monitored named area thresholds in terms of target category, time (minutes), quantity threshold, number confirmed threshold and number engaged threshold.

- The capability to modify engagement area geometry in terms of area name and associated polygon geometry (MGR's).

SECTION 6.0 COMMANDER'S MANEUVER DISPLAY REQUIREMENTS

6.1 REAL TIME MANEUVER DISPLAY

The need for a real time maneuver display terminal to support the division commander is based on the following premise: an appropriate amount of real time information from available division resources in conjunction with the normal intelligence assessment of battlefield status offers the commander a significantly more current picture of the enemy situation. Stated another way, if the commander could "see" enemy activities in real time presented in terms of (1) locations/quantities of moving objects (Movers); (2) enemy artillery and missile locations (Shooters); and (3) locations/quantities of active enemy radars and radios (Emitters), his decision process would be materially improved due to a better, more current knowledge of enemy actions. It is further postulated that the commander's display itself, in order to be maximally useful, must be presented in a manner that emphasizes simplicity, i.e., minimizes clutter and uses symbology that is easily understood with minimum training and limited reference to dictionaries.

Figure 6.1-1 illustrates a concept of operation featuring a large screen, common perception color graphics display for maintaining continuous and current status of the battlefield situation plus a maneuver display analyst's terminal that would be used to monitor maneuver status and compose the common perception display. The analyst would make use of the Real Time Adjuncts (Shooters, Movers, and Emitters), along with conventional display information and message traffic routed to his attention, to stay abreast of the current maneuver situation, update the common perception display, and react to direction from the commander.

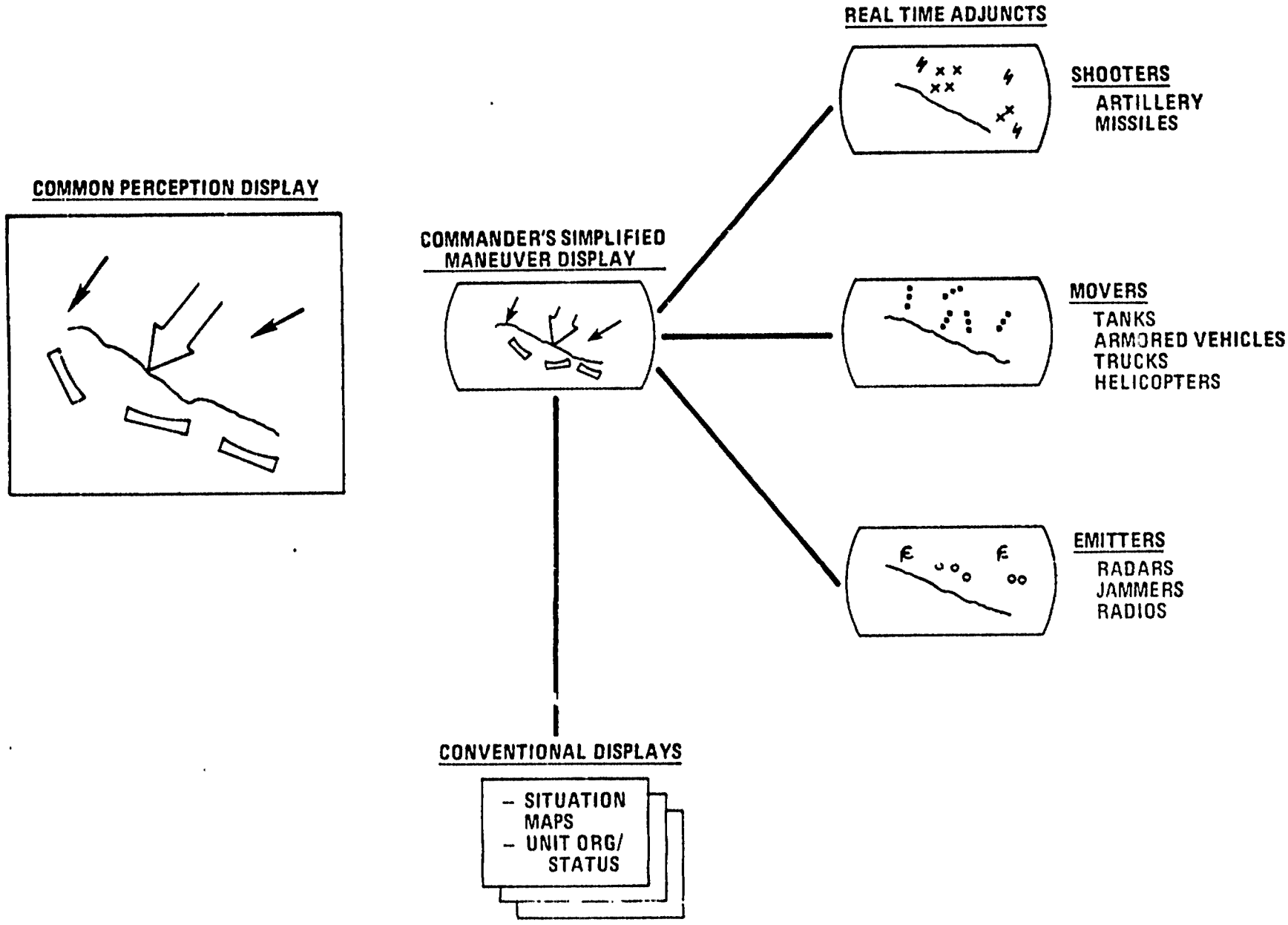


Figure 6.1-1. DIVISION COMMANDER'S MANEUVER DISPLAY CONCEPT.

The Real Time Adjuncts displays do not represent separate terminals, but rather files of real time data from appropriate sensors and other sources that could be called up by the maneuver analyst and graphically displayed on his terminal either alone or in conjunction with other graphic displays. The amount of real time data to be selected/displayed would be a variable controlled by the analyst; thus, he could limit the quantity of data to be displayed to a comprehensible amount, taking into account the degree of battle activity, need for timeliness, geographic area of interest and other factors as required.

A portion of the DIVRAS Experimental Facility has been set up to allow experimentation with this concept. The maneuver analyst's terminal includes both color and black and white consoles, a keyboard, and sets of function keys for manipulating the various displays. A separate table top color console is available for viewing by the commander. Through use of a rear view projection system an approximate 4' x 4' black and white wall display will continuously show whatever is on the commander's color console. This will enable an evaluation of the utility of a large screen display for group viewing as opposed to a large size table top console. Since it will function as a slave to the maneuver analyst's terminal, the same capabilities are available in the large screen display as are included in the analyst's console with the exception of color.

At this phase of analysis it is felt that a minimum of 3 colors would be required to most effectively represent the battlefield situation. They would be used to separate enemy units/activities, friendly units/ activities, and map backgrounds. Graphic capabilities are absolutely necessary in order to adequately represent summaries of large amounts of detailed information. Simplified map backgrounds will also be more effective in reducing clutter and enhancing readability. More detailed versions of maps would be useful at expanded scales. Details on these subjects are included in subsequent portions of this section.

6.2 MAP BACKGROUND

Selection of the most appropriate map background consistent with the purpose and function of the maneuver graphics display is an important aspect of this study.

Topographic detail must be simplified for a CRT display intended for the commander's use in following the overall battlefield situation. A relatively gross level of detail containing certain essential map information appears sufficient, from investigations to date, to support the commander's needs.

Several options for level of map detail were considered:

1. Army standard topographic map to be video projected on the display screen

2. Digitized mid-level map including major elements such as rivers, bridges, primary and secondary roads, larger cities, and a few significant terrain features

3. Digitized outline level map providing only gross map elements and no terrain features.

The DIVRAS Experimental Facility offers the ability to use all three levels of map detail in experimentation. The outline level is useful at the basic map scale of 1:250,000 when displaying the entire battlefield and division reserve areas. It includes the Brazos River, primary roads and bridges, and larger cities. Two additional elements are callable when viewing at expanded scales. The first displays secondary roads, railroads, and additional cities and towns. The second displays terrain features of vegetated areas, swamps and marshes, and elevation high points.

These have all been digitized as separate overlays and are callable by the console operator individually or in any combination with each other or other overlays. Illustrations of the map background overlays to initially be used in experimentation are contained in Figure 6.2-1, 6.2-2, and 6.2-3. Figure 6.2-4 represents military units symbology superimposed on a video image of a standard Army map.

From investigation to date, option 2 level of map detail (combinations of Figures 6.2-1, 6.2-2, and 6.2-3) appears most useful, in support of the commander's maneuver display requirements, and should be structured in callable layers. Considerations influencing this evaluation are:

- o Adherence to the concept of display simplicity and lack of clutter
- o Availability of map background information in digitized form
- o Intelligibility - the mid-level of map detail is easily intelligible; it provides most essential military information and avoids the difficulty of having to read an Army standard map on the CRT screen.

A second question concerning the application of map backgrounds deals with the required geographic area of coverage to be depicted and corresponding map scales. Much of the Army's map work has been keyed to use 1:50,000 scale maps and it was considered appropriate to retain this scale for the graphics work under this contract.

FIGURE 6.2-1. PRIMARY ROADS AND BRAZOS RIVER

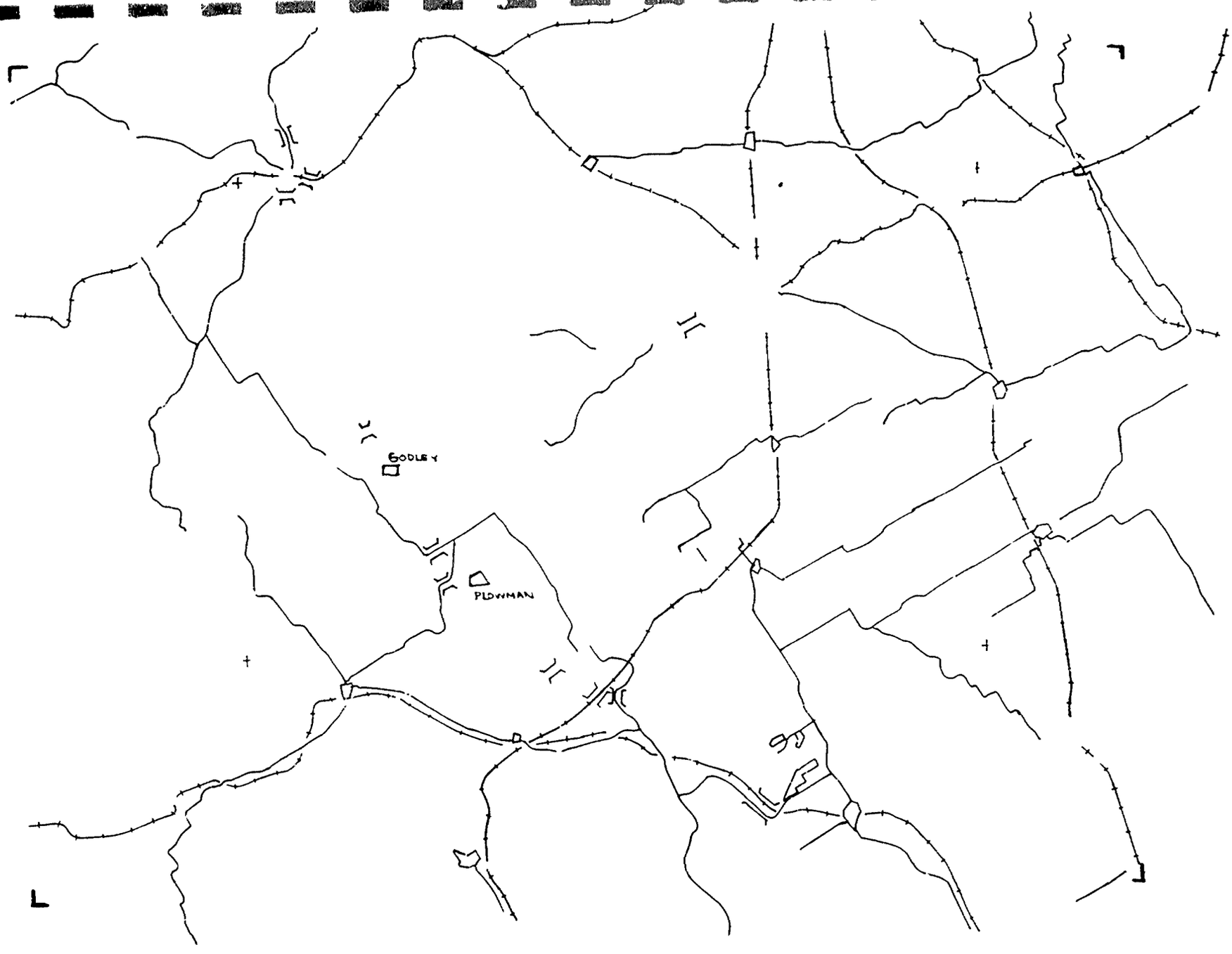


FIGURE 6.2-2. SECONDARY ROADS

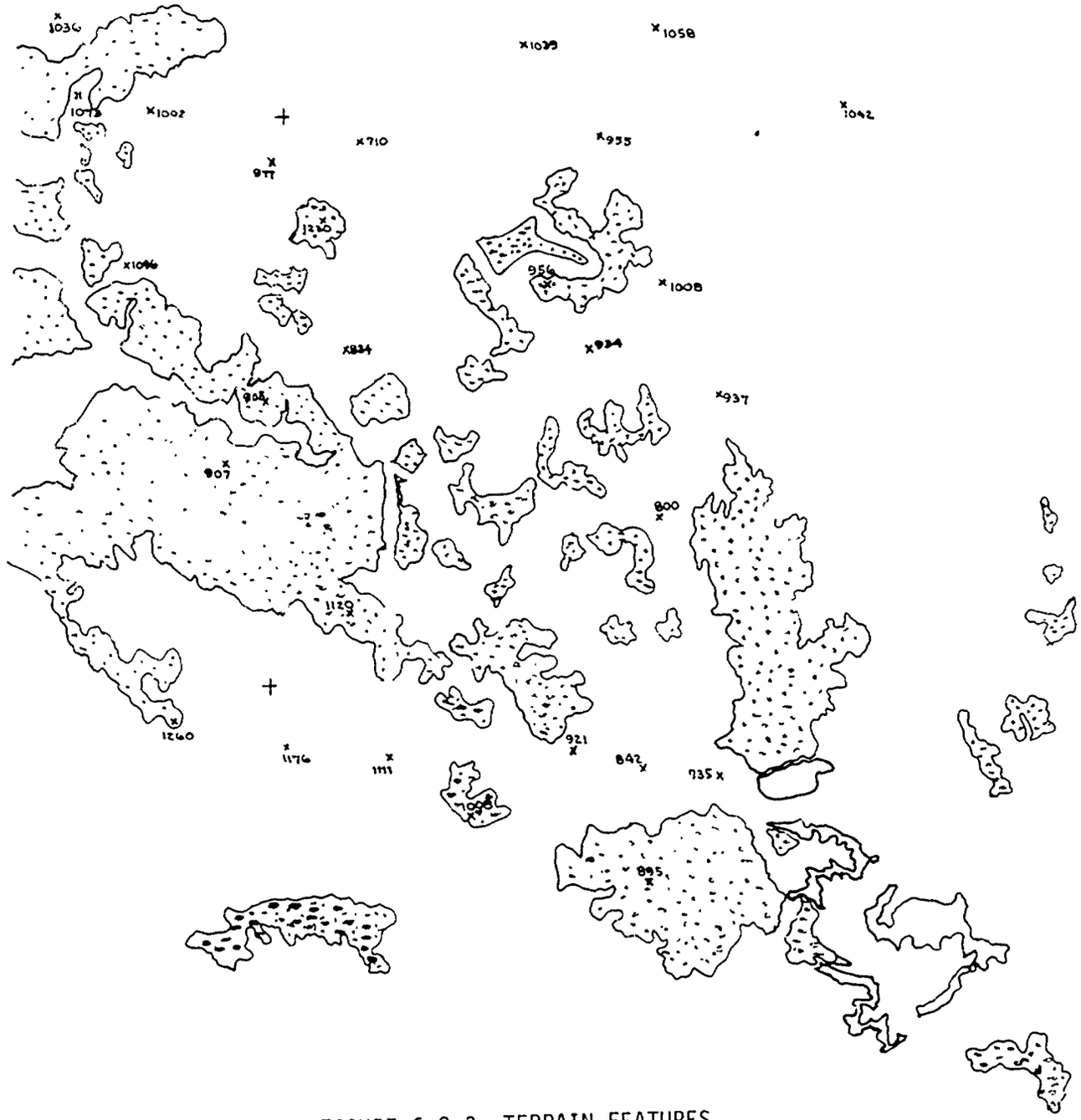


FIGURE 6.2-3 TERRAIN FEATURES

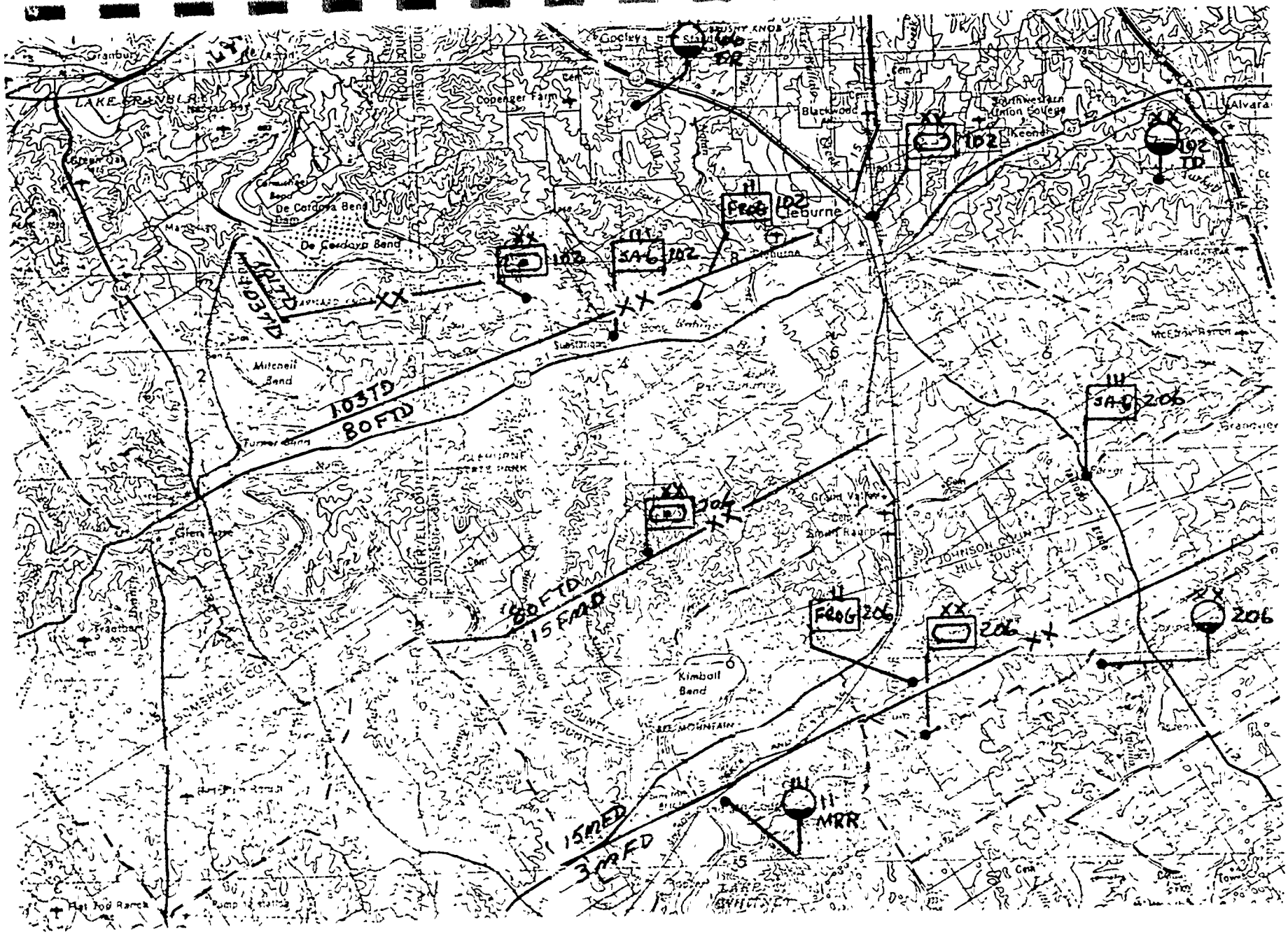


FIGURE 6.2-4. MILITARY UNIT SYMBOLS SUPERIMPOSED ON VIDEO MIXED TOPOGRAPHIC MAP

The 1:50,000 scale when translated onto the 10" x 14" digital television screen results in a viewing area that covers about 14 x 18 kilometers in size. This is considered a satisfactory size for displaying and following the actions of battalions and regiments (the basic maneuver units of a division level force) within their individual zones of responsibility.

To display a larger area, one roughly encompassing the boundaries of a division forward area, a map scale of 1:100,000 is appropriate. This results in a map viewing area on the screen of about 28 x 36 kilometers in size.

The viewing area appropriate to encompass the deployment of full division resources on both the enemy and friendly sides to a depth that includes all reserve elements dictated at least one additional map scale of 1:250,000. At this scale, the resultant area viewed is approximately 70 x 90 kilometers overall.

Experimentation to date has dealt with these three map scales. Work is progressing towards establishing general rules for use of various overlay data at these scales.

In summary, it appears that digitized map backgrounds best support the objective of the maneuver graphics display--that of conveying a total perception of the division battlefield situation in terms of major threat and countering force deployment and movements. This is achieved without introduction of more cluttering map elements. In this approach the additional information available from a standard topographic map would, if required by the commander's decision process, be obtained through other DTOC resources.

6.3 SYMBOLOGY

A primary objective of the graphics effort will be to define and test in the Experimentation Facility new sets of graphic symbols most suitable for maneuver graphics display. Two new symbol sets have been developed; (1) a set for use in the basic threat scene displays intended to depict battle forces as threat and countering forces and (2) a set for use in the adjunct displays to depict the shooter, mover and emitter report data.

The basic threat map or scene replaces the more conventional order-of-battle map. Whereas the OB map traditionally has depicted military units at the battalion and/or company level, in the threat scene approach the individual weapons and units are depicted instead as segmented battle forces consisting of threat and blocking forces. The enemy threat forces are grouped (aggregated) according to their battle objective, an example being a force structured to penetrate into friendly territory and seize a major objective. The display is intended to depict this force in terms of its combat power and convey information concerning its direction of movement, rate of advance and time in a position or area.

Thus, several of the key criteria for design of the threat scene symbol set are:

1. Depict military elements as threat and countering forces showing direction of movement and combat strength number.

2. Symbol design to be suitable for aggregating several elements into a common force.

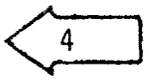
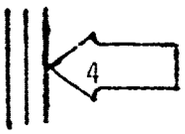
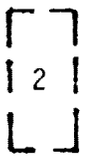
3. Symbol design to convey that an enemy force is in one of several conditions at a given time--a threat force penetrating into a friendly sector; a threat force which is temporarily blocked by friendly force action; or an enemy force which, although in a position to become a threat, is presently assembling or in reserve.

4. Symbol design to be such that its size may be varied to convey additional information, i.e., arrow length elongated to connote higher rate of advance.

The threat symbol set selected for use in the Experimentation Facility is shown in Figure 6.3-1. The open arrow symbol represents an enemy force committed to a thrust or penetration action. A one or two digit numeric inside the arrow connotes maneuver battalion count. An enemy force in position to become a threat but presently not moving, is represented as an irregular shaped circle or amoeba. On the friendly side, the forces committed to a countering or blocking effort are represented by an open rectangular block with its longer side faced to the enemy. It can be annotated to indicate battalion count. A group of three close-spaced parallel lines at the point of an enemy threat arrow connotes that the enemy force is currently blocked in that position.

Threat symbology will be used in conjunction with standard unit symbols per FM21-30. The Experimentation Facility has the capability to construct unit symbols from their various elements. Figure 6.3-2 shows elements currently in the standard symbol library; these can be varied as requirements dictate.

The adjunct display provides the means for displaying an integrated picture at any given time of shooter, mover and emitter data collected over predetermined time intervals. A typical adjunct display as used in

TITLE	SYMBOL	NOTES
Threat Force Advancing		• 360° orientation capability for indicating direction • Numeral(s) for indicating count of maneuver battalion
Threat Force Blocked		• Three parallel lines and arrow are in opposite colors
Stationary Force		• This symbol is used for a force in reserve but capable of becoming a threat force within a specific time interval
Blocking Force in Position		• 360° orientation capability for indicating direction • Numeral(s) for indicating count of maneuver battalions
Blocking Force at Planned Position		

Additional Notes:

1. The size of the threat arrow and blocker symbols can be controlled via the analyst's console for purposes of graphically indicating combat power or rate of penetration.
2. Additional symbols used in displaying an overall threat scene may include standard military unit symbols in the rear areas.

FIGURE 6.3-1. SYMBOL SET FOR MANEUVER GRAPHICS DISPLAY

I ECHELON

ARMY	Army	XXXX
CORP	Corps	XXX
DIV	Division	XX
BRIG	Brigade	X
RGT	Regiment	III
BN	Battalion	II
CM	Company	I

II UNIT DESIGNATIONS

UNIT	Unit	Rectangle
AA	Army Air	Propeller
AB	Airborne	Gull's Wings
AD	Air Defense	Radar Dome
ATY	Artillery	Cannon Ball
CAV	Cavalry	Bandoleer
ENG	Engineer	E - On Side
INF	Infantry	Crossed Strap
MECH	Mechanized	Tank Track
TRAN	Transportation	Wheel
MSSL	Missile	Warhead

FIGURE 6.3-2. STANDARD SYMBOL LIBRARY

our experimentation might show disbursement across the division front of from 80 to 100 mover symbols; the emitter adjunct display might show deployment of from 150 to 300 radar and communications transmitter detections, the total number being a function of the time interval specified for collecting and saving data.

The symbol types for use in this set have been initially determined from analysis of the capabilities of pertinent sensor systems. These types are shown in Figure 6.3-3; they can be readily modified and expanded and the set shown in the figure is considered to be a minimum.

The intent of Adjunct displays is to show patterns of current enemy activity against a map background and last known enemy positions. Thus, the method for connoting counts of items is a key consideration and will be subject to further analysis and experimentation. One method used for movers has been to let each symbol placed on the screen represent from 1 to 10 movers. Thus, a report from SOTAS indicating that 27 moving vehicles had been sighted would be reflected on the display as 3 mover symbols.

Emitters, on the other hand, have been handled by using a small sized symbol (a dot) and displaying one symbol for every communication emitter location reported. Shooters are represented by a somewhat larger circle for each firing reported.

A second key aspect of determing effective symbology is the selection of time intervals over which data from each sensor will be collected and displayed for each type of adjunct. An initial set of overlays has been built based on the following amounts of data:

TITLE	SYMBOL	NOTES
EMITTERS		
Radar		Each symbol displayed represents an emitter detection made during a predetermined time interval
Communications Emitters		
SHOOTERS		
Artillery		Each symbol displayed represents detection of a gun firing during a predetermined time interval
Missile or Rocket		
MOVERS		Each symbol displayed represents detection of from 1 to 10 movers during a predetermined time interval
Tracked or Wheeled Vehicle		

FIGURE 6.3-3. SYMBOL SET FOR ADJUNCT DISPLAY

MOVERS	SOTAS	60 Minutes
	GSR TACFIRE	30 Minutes
	TACFIRE FO's	15 Minutes
SHOOTERS	AN/TPQ-37	30 Minutes
	FAALS	30 Minutes
EMITTERS		
Radars	Teampack	120 Minutes
	Quicklook	120 Minutes
Comm	Trailblazer	15 Minutes
	Guardrail	60 Minutes

A need exists for continuing detailed tradeoff analyses on the question of the most advantageous time intervals for saving and integrating classes of adjunct data.

The symbol sets described herein have been implemented in the DIVRAS Experimental Facility. Through further exercising of the demonstration capabilities with Army personnel in attendance more evaluative data will be obtained toward a set of initial symbol specifications.

6.4 MANIPULATION CAPABILITIES

The current contract requires development of the requirements and presentation options for a simplified commander's display to support maneuver through the use of an experimental display facility. IBM's Color-Graphics Digital TV Display System was selected as the most appropriate base capability on which to build this aspect of the DIVRAS Experimentation Facility. Capabilities inherent in the Facility include the ability to: 1) display digitized map backgrounds and/or video mixed real-map backgrounds; 2) build standard military symbols from a library of symbol elements; 3) modify, move, or delete these symbols through keyboard and/or function key controls; 4) display these and other data in 3 basic colors (red, blue, green) and employ, with certain restraints, 3 additional colors representing combinations of the basic colors, 5) draw solid and dashed lines on the screen; 6) annotate symbols with alphameric data entered through keyboard; and 7) store and recall specific display screens. These general capabilities were adapted (in many cases augmented) to scenario requirements described in Section 3.0. System controls permit building/storing additional Threat displays plus construction of Adjunct displays representing different time intervals and thus varying quantities of data to be displayed.

Figure 6.4-1 tabulates general manipulation capabilities now available on the DIVRAS Experimentation Facility for experimentation/demonstration purposes under this contract. For the three general types of displays (Backgrounds, Threats, and Adjuncts) a brief description of capabilities is included under the two major modes of operation: compose and demonstrate. Also shown are the colors that will normally be used for the scenes described.

TYPE OF DISPLAY	COLOR USED	COMPOSE MODE	DEMONSTRATE MODE
BACKGROUND DISPLAYS	GREEN	• Using cursor, digitize line drawings of simplified map backgrounds including roads, rivers, towns, grids, terrain features; annotate with appropriate alpha-numeric labels • Display video image of standard Army map; superimpose symbology representing battlefield situation	• Call/Delete Primary Roads • Call/Delete Secondary Roads • Call/Delete Terrain Features • Call/Delete Grid Indicators Display above overlays singly or in any combination; call one or more as background to threat scenes and/or adjuncts.
THREAT DISPLAYS	RED & BLUE	• Build overlays on map backgrounds depicting enemy and friendly situation using standard unit symbols and special threat symbols; store/recall full scenes including backgrounds • Draw solid lines representing major unit boundaries. Label appropriately. Draw dashed lines representing FEBA.	• Call/Delete Threat Scene Overlays • Add, delete, move, modify, annotate situation symbols superimposed on any map background (for symbology description see Section 6.3) • Aggregate unit symbols into threats and blocking forces to simplify presentation, show relative combat power and direction of movements
ADJUNCT DISPLAYS (Shooters, Movers, Emitters)	RED	• Build overlays using special symbols (Section 6.4) depicting locations/quantities of movers, shooters, emitters over a specific time period. Annotate as required.	• Call/delete full scenes of shooters, movers, emitters for superimposition over map backgrounds and/or full threat scenes. (Individual symbols not interactive)
GENERAL		• Build scene; store/recall from temporary working file • Swap colors among major data sets (Enemy, Friendly, Map) • Create additional colors by combining basic set	• Offset and expand in even increments (X1, X2, etc.) all data on screen (maps and overlays) • Advance to next scene, or advance/return to a specified scene in a sequence

FIGURE 6.4-1. MANIPULATION CAPABILITIES OF COLOR GRAPHICS EXPERIMENTATION FACILITY

Although the DIVRAS Experimentation Facility is well equipped to conduct on-going experimentation, it should be pointed out that the final graphics manipulation requirements to support maneuver functions will likely vary somewhat from those outlined in Figure 6.4-1. One objective during the balance of this contract phase will be to definitize and specify not only manipulation requirements but also symbology and map background requirements as a result of experimentation and Army reviews.

6.5 OVERLAYS

Previous sections have described the DIVRAS Experimentation Facility in terms of map backgrounds, symbology, and manipulation capabilities selected/developed for use in definitizing requirements. This section will describe how these elements will be assembled into representative displays or scenes that depict battlefield status at a level appropriate to support the division commanders.

Figure 6.5-1 illustrates all presently defined sets of data in overlay form available the maneuver analyst in the DIVRAS experimentation Facility. The data for each overlay was derived from scenario events (Section 3.0) and represents what are felt to be realistic summaries derived from sensor inputs, intelligence reports, and maneuver reports. Although shown here as overlays to illustrate the approach taken in the Experimental Facility, in the operational system each subcategory of data would probably be handled as a data file or file set with attendant processing on input and output.

Each type of overlay will be described in more detail in the following paragraphs.

Map Backgrounds - Illustrations of each of the 3 digitized map backgrounds plus the video map were included in Section 6.2.

Threat Displays - Figure 6.5-2 is an overlay of a conventional situation display showing enemy and friendly unit locations, types, and nomenclature at a given time. Friendly forces are normally in blue, enemy forces in red. These overlays would be superimposed on an appropriate map background in green.

Figure 6.5-3 illustrates a similar situation of enemy and friendly forces but in this case has represented frontal units in terms of

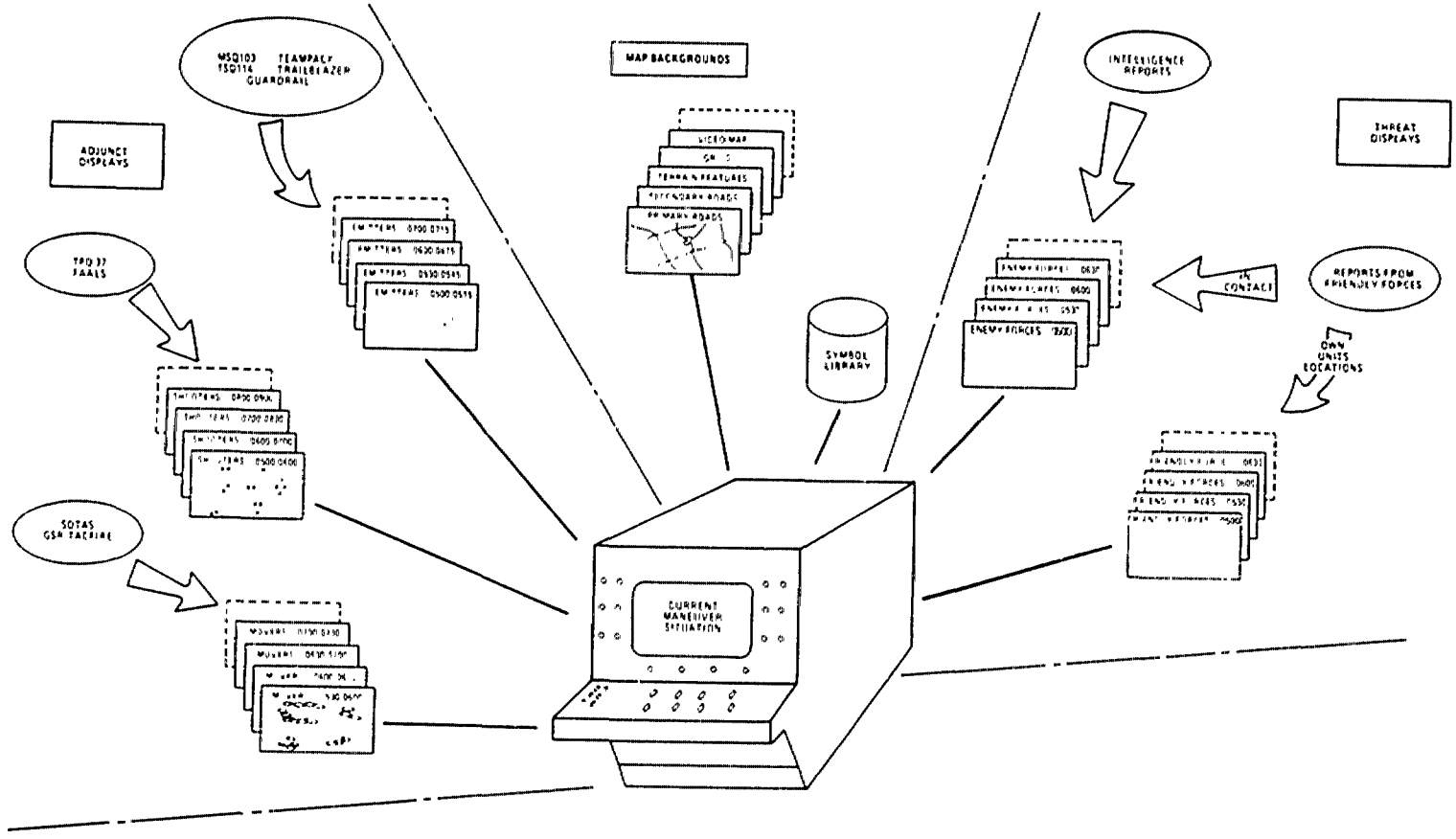


Figure 6.5-1. DATA AVAILABLE TO MANEUVER ANALYST.

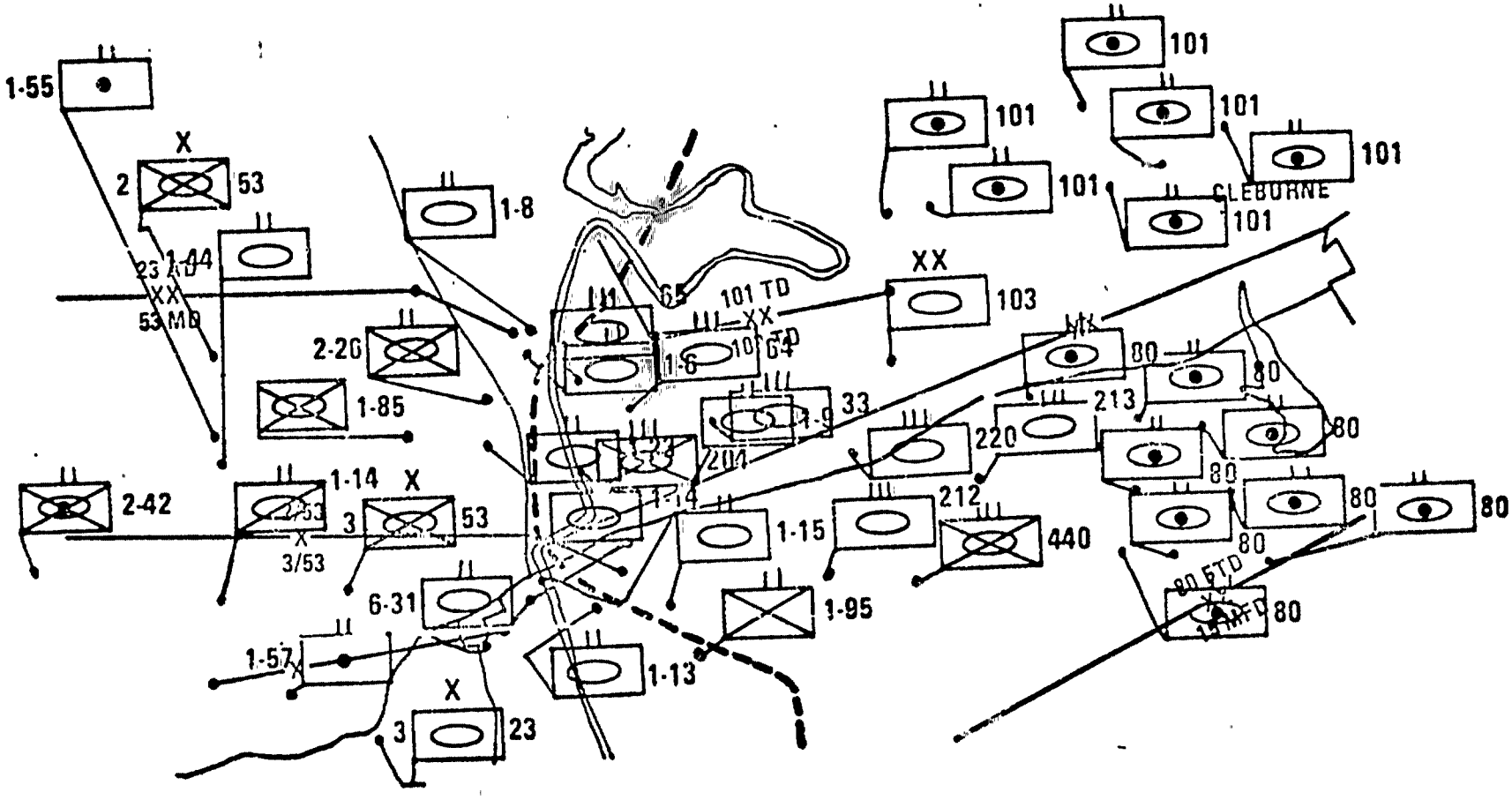


FIGURE 6.5-2. CONVENTIONAL SITUATION DISPLAY

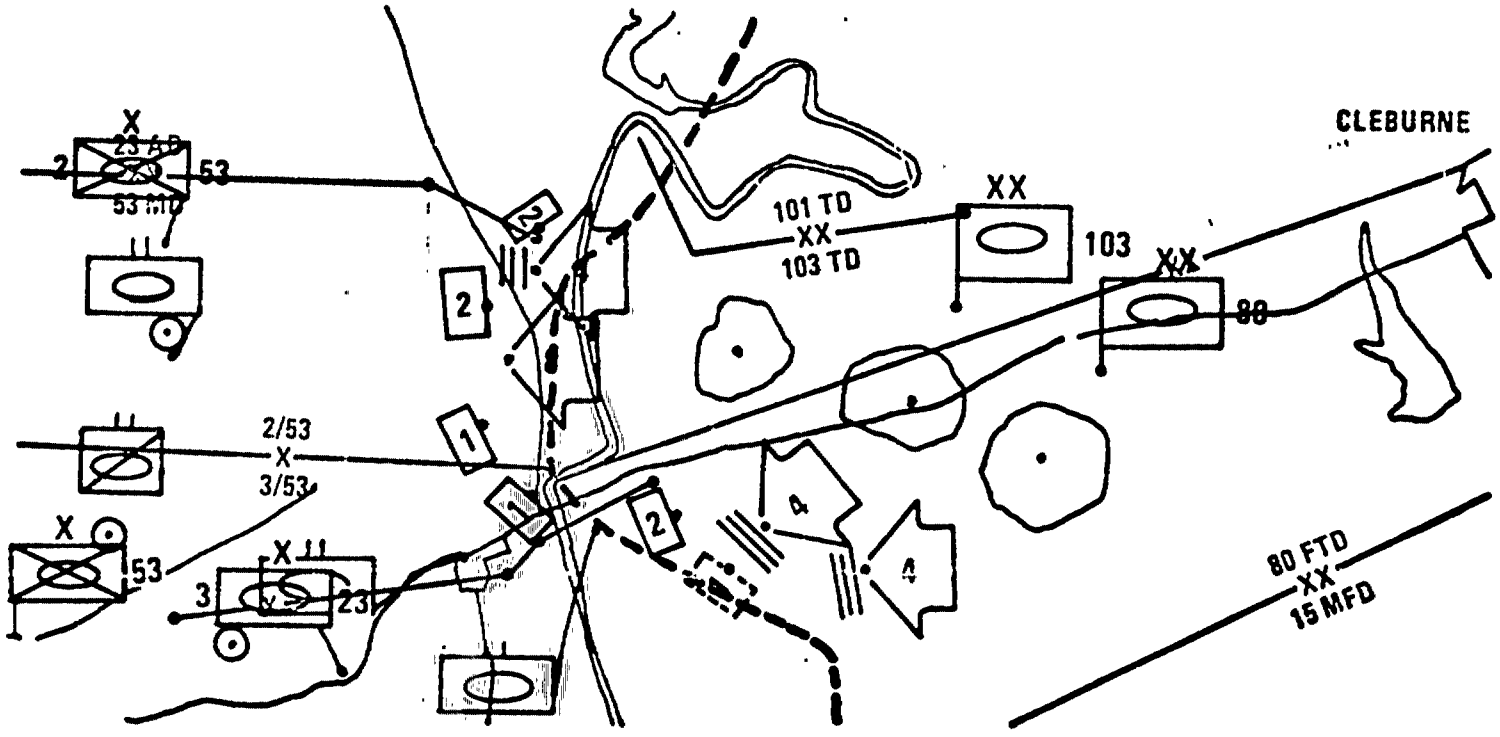


FIGURE 6.5-3. THREAT DISPLAY

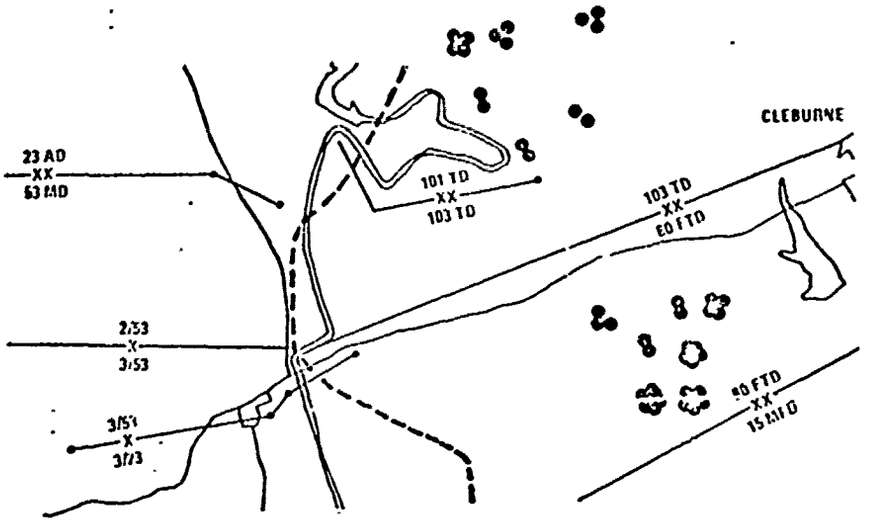
threat symbology so as to simplify the picture. The arrows and circular shapes on the right are enemy moving and stationary forces, respectively. The triple lines in front of some of the arrows indicates an enemy force halted by our forces. The rectangular shapes are friendly blocking forces (dashed lines represent planned positions). The numbers included within the symbols show force strength in terms of numbers of battalions. Color coding would be the same as for the conventional situation display.

Adjunct Displays - Figure 6.5-4 illustrates each of th adjunct display overlays using symbology described in Section 6.3. The data represents approximately 60 minutes of mover reports, 15 minutes of emitter reports, and 30 minutes of shooter reports. It is planned to experiment with these time intervals and symbology to determine optimum mixes of data currency and screen intelligibility--i.e., how much can be displayed at one time and still remain understandable.

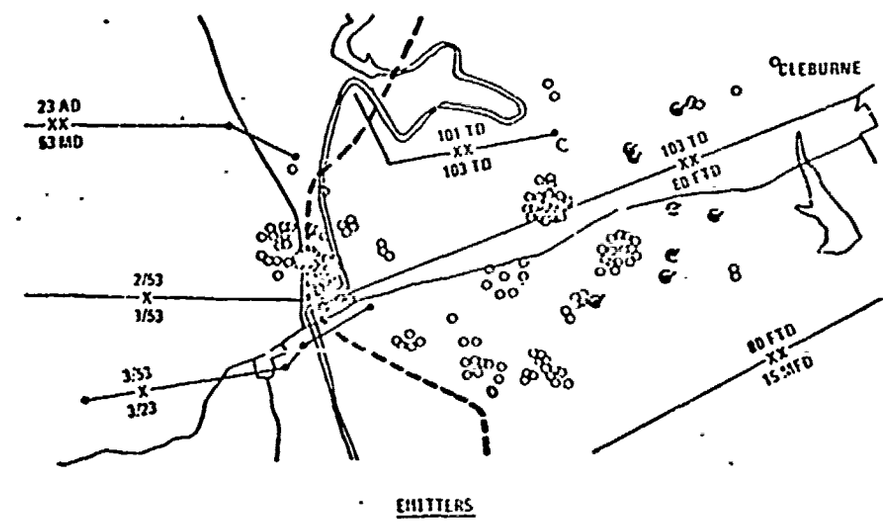
Overlay Combinations - Figure 6.5-5 illustrates how map backgrounds, threat displays and adjuncts (in this case emitters) will be combined to portray battlefield status during experimentation. Initial operational concepts involve use of the adjunct displays (particularly movers and emitters) to provide near real-time information on enemy movements and/or SIGINT activity, and therefore be a means of updating probable enemy locations. A typical sequence of display operations mught be as follows:

1. Display latest enemy unit locations on simplified map background (Figure 6.5-2 and Map).

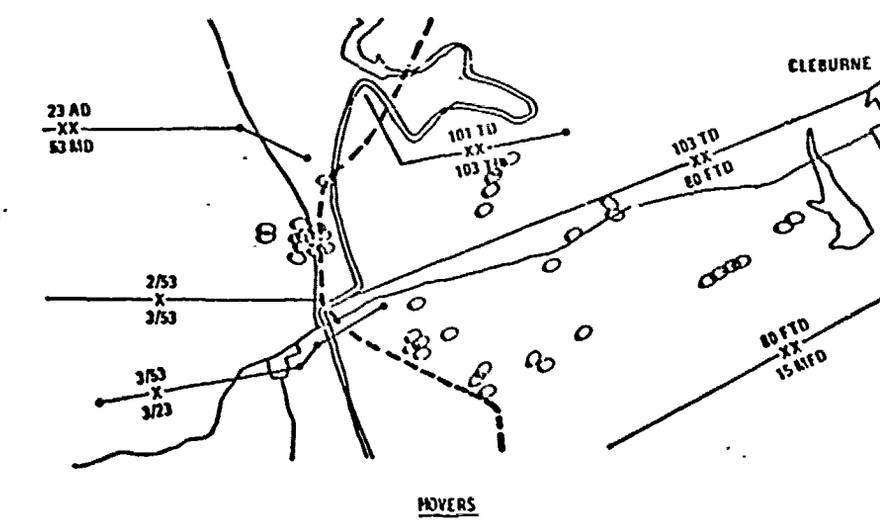
2. Simplify division level area of interest by aggregating enemy and friendly frontal units into threats (arrows), stationary forces (amoebae), and blocking forces (rectangular "blockers")



SHOOTERS



EMITTERS



MOVERS

FIGURE 6.5-4. ADJUNCT DISPLAYS

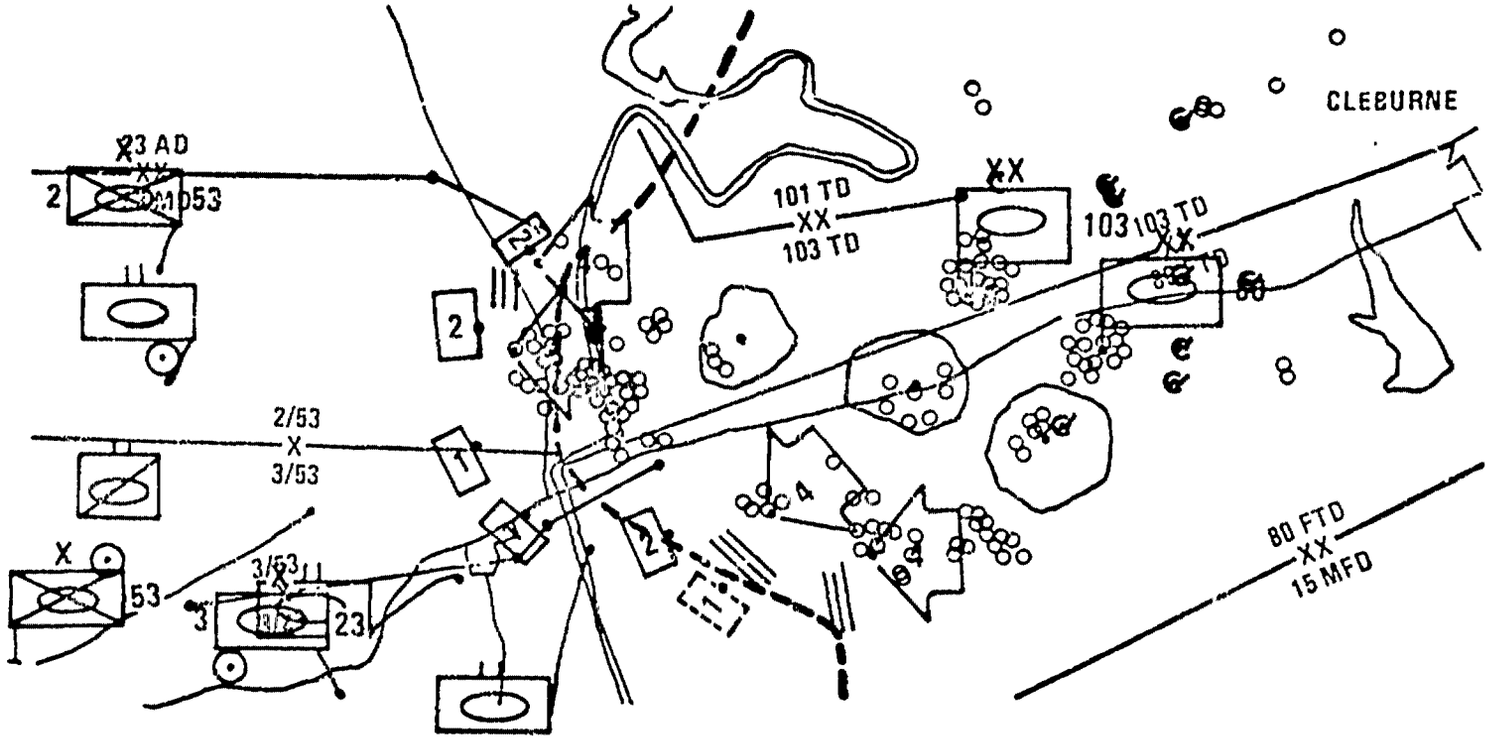


FIGURE 6.5-5. THREAT DISPLAY PLUS EMITTERS ON MAP BACKGROUND

3. Call up movers display superimposed on threat display and map. Look for instances where detection of movers indicates threat may have moved from previously known location.

4. Delete movers and call emitters. Compare active emitter locations with previously known enemy threat locations. Using interactive display capabilities adjust location of enemy threats as indicated by mover/emitter data. (Possibly call movers and emitters together with threat.) Similarly, shooter reports (overlays) can be used to confirm suspected locations of enemy artillery and missile placements, and the maneuver display picture updated accordingly.

The use of these overlays in combination, the type of operator interaction needed to incorporate changes into the maneuver display picture, the "right" mix of adjunct data considering currency versus completeness versus clutter are some of the dimensions subsequent experimentation will examine.

7.0 WORKSHOP EXPERIMENTATION AND RESULTS

DIVRAS experimentation workshops were held in June and July, 1977 at IBM-FSD's Gaithersburg, Maryland facility. Approximately 100 persons attended the 13 workshops. Organizations represented are listed in Table 7-1.

Workshops were conducted as follows: The session commenced with a vu-graph briefing presented by the BSI project officer. This served to orient the attendees by providing a statement of the Army Vice Chief's guidance concerning tactical ADP development, a brief contract status summary and more detailed discussion of the objectives and methods used to conduct the DIVRAS software definition/development effort to date. At the end of the briefing and before proceeding to the demonstration room, attendees were introduced to some actual display features by use of a remote digital television monitor driven from the demonstration system.

The demonstration of interactive display capabilities and the proposed applications of maneuvers and targeting displays in a concentrated period of battle were conducted in a laboratory configured to approximate the size of an operational field shelter such as that currently used in DTOC deployments.

In order to illustrate the concept of operations, the displays, the processing software, and the interactions available to the analysts at the maneuver and target analyst terminals, a 15 to 20 minute scenario of events was run through.

TABLE 7-1. ATTENDEE ORGANIZATIONS

U. S. ARMY

Assistant Chief of Staff, Intelligence (ACSI)
Army General Staff Management Information Systems Directorate (MISD)
Army Materiel Systems Analysis Activity (AMSAA)
Army Research Institute (ARI)
Army Tactical Data Systems (ARTADS)
Combined Arms Combat Development Activity (CACDA)
Computer Systems Command (CSC)
DARCOM Directorate for Battlefield Systems Integration (DARCOM/BSI)
DARCOM Directorate for Development and Engineering (DARCOM/DE)
DARCOM Headquarters
Deputy Chief of Staff for Research, Development and Acquisition (DCS/RDA)
Deputy Chief of Staff for Operations and Plans (DCS/OPS)
Electronic Research and Development Command (ERADCOM)
Intelligence and Security Command (INSCOM)
Office of the Secretary of the Army
Program Office, Stand Off Target Acquisition System (SOTAS)
TRADOC Combined Arms Test Activity (TCATA)
TRADOC Headquarters
TRADOC Systems Analysis Activity (TRASANA)
U. S. Army Europe (USAREUR)

OTHER

British Army
Defense Advanced Research Projects Agency (DARPA)
DOD Research and Engineering (DDR&E)
Institute for Defense Analysis (IDA)
U. S. Air Force - Tactical Air Command (TAC)
U. S. Marine Corps

Input message traffic for enemy shooter, mover, and emitter data had been derived from an earlier off-line simulation through which a total of approximately 6,000 detection reports had been derived for a battle period of 6 hours duration. In addition, normal message traffic from friendly units was incorporated to reflect scenario events. This segment was demonstrated to exercise a wide variety of the interactive capabilities of the DIVRAS software design.

Following this phase of the demonstration, the workshop session was opened for specific questions and discussion. Attendees were encouraged to utilize the interactive controls to manipulate graphics and launch their own queries. The maneuvers display had provisions to allow situation threat scenes to be created or modified and then directly compared on the screen against prestored "ground truth" data.

The final portion of each session was conducted back in the briefing room, giving attendees the opportunity to offer additional comments and suggestions for using and enhancing the concepts.

From these sessions, a group of 26 questions or basic issues has been identified. These fall into 5 basic categories as follows:

1. Operational Considerations

   These are issues related to possible changes in the DIVRAS concepts for configuration, interfacing, etc. An example would be a concern raised by attendees that the DIVRAS maneuvers display function might more appropriately be placed with the division G2 function.

2. Application Considerations

These are issues requiring the addition of applications beyond maneuver and targeting displays. The experimentation, for example, did not address such areas as sensor management, bomb damage assessment, etc.

3. Additional Functions

In this category are issues requiring functional additions to the maneuver and targeting display capabilities but which do not represent different applications. An example is a suggestion made at several of the workshops that an Air Defense Display be added to the existing maneuvers display function. In most cases, additions in this category do not represent a significant new technical dimension if implemented with the DIVRAS existing applications. The issue is whether the addition produces an enhancement in the DIVRAS function.

4. Parameter and Algorithm Changes

These are issues requiring parameter and/or algorithm changes to functions already in DIVRAS. An example stems from a suggestion made at several of the workshops that there be provided a capability for target-of-interest work queue management.

5. Hardware and Human Factors Considerations

Some of the recommendations fit into the category of hardware and human factors changes. In the present concept, for example, the targeting analyst introduces changes to the engagement

rules one at a time. A suggestion was made that consideration be given to having a mode control capability that when actuated would define to the system a different set of parameters for controlling the targeting algorithms.

The following paragraphs present a more detailed discussion of the suggestions for additions, changes and enhancements applicable to the DIVRAS concept.

7.1 OPERATIONAL CONSIDERATIONS

Integration of Maneuver Display Into the Intelligence Function

There was considerable concern during the workshops that the Maneuver Display application is essentially a design to shortcut or replace traditional intelligence analysis at the Division and that the result would be poorer command decisions. The concerns centered on several specific issues. The first was the perception that DIVRAS is designed to replace the tactical intelligence function. The second is that DIVRAS would be utilized by the commander to make maneuver decisions without having all the information available. The third is that the only effective approach to interpreting and updating the maneuver situation display would be to locate the function at an intelligence analysis facility.

It should be noted that the DIVRAS does not replace the traditional intelligence analysis function, but is designed to complement it. DIVRAS utilizes directly combat information that can be used in real time to influence targeting or maneuver operations. The concept recognizes that the well analyzed intelligence product is higher value information than combat information and the system incorporates automatic data base and analyst update capability to add such information to the total situation picture. Unfortunately, the analysis of intelligence data by nature of the process leads to delays in providing the product to the commander. In the absence of this product the DIVRAS provides the commander with a real time picture of the battlefield by which he can use his tactical judgement to make decisions which need to be made immediately. Certainly the commander would continue to discuss his analysis of the situation with the Division G2 before taking action. However, without real time indicators there would be nothing to prompt the commander to start such actions.

A final consideration in this issue is that DIVRAS is designed to support the commander rather than the analyst. To place total responsibility for developing the battlefield situation at the intelligence analysis facility would make the process less responsive to the desired end products, maneuver and targeting. By allowing the commander to interpret and set priorities based on his judgement of what is significant in terms of the total operational situation, the process can become more timely and effective.

Real Time Data For Friendly Force Location

An issue was raised during the workshop concerning the desirability or feasibility of utilizing real-time sensor information to identify the location of friendly forces in much the same manner as the data is used for interpretation of the enemy situation. The desirablity of such an approach hinges on two assumptions: that the command, control and communications for friendly force reporting is not sufficiently responsive; and that the use of sensor assets to support this function will not detract from the primary mission.

The approach is certainly limited to the presentation of mover and emitter activity associated with friendly forces. Since present sensor technology cannot differentiate moving vehicles the decision on friendly or enemy would rely on knowing the current FEBA and possibly a vehicle direction. Effective use of friendly emitter data would depend on a substantial, continually updated data base of tactical frequencies in use by friendly forces. The processing necessary to make this determination is certainly much more sophisticated than the current maneuver graphic techniques used in DIVRAS.

The technique of friendly force tracking would be more compatible with DIVRAS if it were limited to identifying unknown force groupings

in the friendly force areas and attempting by other means to identify such forces. Such data would be incidental to the present method of operation and would not detract from prime mission performance.

Continuity of Operations

The question was raised during the workshop sessions as to what provisions could be made for continuity of operations if the automated system which supported DIVRAS were degraded or fails.

Any implementation of the DIVRAS applications must provide a manual back-up capability to continue the functions even if there is a system failure. For DIVRAS it is anticipated that alternative termination of the input communication lines with hard copy output would be most useful. The key factor, however, in continuity of operations is that the DIVRAS applications are compatible with a manual approach. The maneuver display offers a faster more flexible version of the manually updated situation map; and such an implementation could be used in a degraded mode.

In the targeting application there is significant processing which allows the operator to associate information about the same target. Manual procedures based on location, target type, and source could also be used to provide the same function, albeit at a much slower rate. In such cases targets would have to be prioritized on a very simple value system.

Level of Interoperability

It was observed in the workshops that the DIVRAS concept posed significant questions relative to interoperability. The DIVRAS applications require that the system on which the functions are implemented offer a capability for information exchange which is compatible with the anticipated volume of data, and real time action on combat information. This exchange must occur with a variety of systems which have different data types, different levels of automating and different IOC dates. DIVRAS must therefore support a concept that is consistent in terms of the concept of data exchange, but open-ended and flexible in terms of implementation.

The level of interoperability needed to meet the DIVRAS requirements is the key issue. Three separate levels have been suggested. The first is the terminal approach in which each sensor system facility would be provided a terminal which is compatible with the DIVRAS implementation system and the sensor system operator manually enters data derived from the sensor.

The second approach is to provide within the DIVRAS implementation the capability to place standing requests for information (SRI) against each of the sensor systems, as well as selected predefined queries. Such requests are acted on by the sensor system processor and the results present to the local system operator for release to DIVRAS. This requires a semi-automatic interface.

The third approach is to provide full computer networking between DIVRAS and the sensor systems such that any operator in the network can place and automatically receive data base queries and the results of an SRI at any system. In this case the information distribution at various nodes is transparent to the DIVRAS users.

Of the three, the second approach of limited semi-automatic interoperability between systems offers the best combination of response time, data validity, flexibility, and compatibility with operational considerations.

Automated Fire Missions

The real time targeting application in the DIVRAS Workshop was designed to allow the operator to review computer recommended fire missions before they were sent. A question was raised about allowing those that meet the specified rules to go to TACFIRE automatically, i.e., without operator review.

In times of intense battle activity this would be a means of improving the efficiency of the real time targeting application. There could be more output from the function, the operator's message queue would be reduced, and his time saved.

There are classes of target opportunities that are almost indisputable fire missions. However, sending a fire mission to TACFIRE does not guarantee that it will be fired. It goes into the system queue, and consequently becomes subject to their specific priorities and resources situation. Human judgement comes into play at that level.

The DIVRAS targeting analyst, by virtue of working with the overall targeting situation and being exposed to the maneuver situation and general command environment, often has personal knowledge not in the computer data base relative to priorities, weapon resources, and status. Any of these could cause him to not send a computer recommended fire mission even though it met all the specific criteria. This could be true especially at times of change in battle strategy.

7.2 APPLICATION CONSIDERATIONS

Battle Damage Assessment

The expansion of the targeting applications into other areas of responsibility of the Fire Support Element (FSE) was a recommended improvement in a number of workshops. The most significant of these recommendations was the addition of a Battle Damage assessment capability to provide the FSE with feedback on targets that had been eliminated or disabled.

The concept in this approach is that targets which had been identified, fired upon and eliminated could be deleted from the data base and prevent later confusion with other incoming target reports.

To actually implement this improvement so as to provide any worthwhile assessment to the analyst in a timely manner would require the addition of a complete new application. Battle damage assessment is an involved process requiring the fusion of data from multiple sources. This is particularly true of non-line-of-sight targets which are the major category addressed by the DIVRAS application. There are few sources capable of providing battle damage assessment for such targets, particularly in anything near real time. Also, accurate determination of the "killing" or disabling of individual targets is a significant processing and analysis function independent of the current application.

Should the battle assessment application be implemented, the impact on the present targeting application would be minimal, requiring only a selective purge of those target intelligence messages associated with the original fire mission. In this sense, the DIVRAS applications are readily compatible with an effective and timely battle damage assessment capability. However, addition of this application to the

DIVRAS does not appear to be compatible with the overall concept of dealing with near-real time information.

Sensor Management

One of the most frequent recommendations during the DIVRAS workshops was that a sensor management capability be added to the present applications. The complexity of these recommendations varied from a simple status file of the operating condition of all input sensor systems to the full capability of reconnaissance and surveillance management of sensor assets.

Certainly the operational benefits of a sensor management capability being added to the DIVRAS applications are significant. The output from the targeting and maneuver applications can be utilized effectively to cue or redirect specific sensor missions and thereby make sensor assets extremely effective. This would be a considerable improvement over the present tasking which is done well in advance of the actual collection. The use of DIVRAS to identify key areas or target types for which more data is needed is a natural continuation of the present applications. In the targeting processing the missing information needed to fulfill the requirements for worth, location accuracy, and permanence can be readily developed and measured against a data base of sensor capabilities operating areas, and mission times to recommend the tasking of a particular asset in near real time.

The question of whether this application is implemented in DIVRAS is dependent on other issues:

- Do the sensors have the capability to respond rapidly to DIVRAS mission requests?

- Can sensor resource status data be provided to DIVRAS and be kept current?

- Since there would still be a requirement for a significant sensor management, planning and control capability at another Division or Corps echelon facility should all but the sensor status monitoring be external to DIVRAS?

The addition to DIVRAS, however, of a sensor management capability which enables DIVRAS to generate sensor mission requests based on voids in targeting data and maneuver indicators does appear to be compatible with the operational concept and readily implementable.

7.3 ADDITIONAL FUNCTIONS

Automated Templating

The question was raised as to whether the commander's maneuver display would be amenable to use of some form of automated or semi-automated templating, i.e., applying an intelligence-developed model of enemy tactics, capabilities, and ultimately the enemy's potential courses of action and intent. The idea is to use pre-defined patterns of enemy activity to cue the maneuver analyst so that he may investigate further. An example would be using the computer to alert the analyst whenever enemy artillery units are moved to a forward position where 50 percent or more of their range extends beyond the FEBA. This generally indicates an impending attack.

Any enemy activity th·, has been established as being a high probability indicator of enemy intent, and which can be reduced to a logical model for programming into a computer, is potentially of value to the maneuver analyst. The decision to incorporate into the system is a tradeoff between processing load (how much computer capacity would be used on what frequency) versus the value to the commander of the resulting pattern analysis. There have been Army studies made of the utility of specific computerized tactical templating applications that could be reviewed for potential inclusion in a DIVRAS implementation.

Use of templates reflecting enemy deployment doctrine in conjunction with shooter/mover/emitter overlays would seem to hold promise. The real-time adjunct data might possibly be utilized to validate the suspected formation of an enemy attack force.

Any procedure that complicates the display and/or requires minutes of time to develop should be viewed with caution, however. In an intense battle situation, operator interactions will be at a saturation level just maintaining status quo.

Significant criteria to be considered in selection/implementation of this type of capability are as follows:

- Is the particular template amenable to processing in a real-time environment? Can it be done simply and quickly to reach an indicator meaningful to the real-time environment?

- Can it be programmed to be either totally automatic (requiring operator review of results only) or require very few simple interactions?

Automated Cluster Analysis of Enemy Situation Data

It was stated during the workshop that there have been successful experiments in performing computerized cluster analysis of enemy situation data, i.e., deducing unit identification/location using algorithms that associate patterns of radar types, communication emitter frequencies and other sensor detected intelligence inputs with specific enemy unit profiles. The question was raised as to the value of this capability in a DIVRAS environment.

The prime objective of the maneuver display analyst is to bring the battle situation status display up to real-time currency for use by the commander in decision-making. Presentation of current, accurate enemy location is obviously the key need. Proven computerized algorithms that could be used in conjunction with real time adjunct data (shooter,

mover, emitter) to identify locations of specific enemy units would be a useful aid to the maneuver analyst, assuming the computer processing required does not consume a significant amount of time or computer resource. However, this approach would appear more suitable for a Corps level implementation.

Weather Overlay

This issue deals with the desirability of handling and displaying weather data for the areas in which the Division and Corps are operating. Questions arise as to how this data would best be stored and kept current. Should it be maintained in the DIVRAS data base as an added function or should the DIVRAS system access this information through interconnection to a central source for the theatre of operations.

If introduced into the DIVRAS concept, it would appear best to integrate it within an overlay of broader tactical use, perhaps related to the intelligence preparation of the battlefield. Such an overlay would present the total impact of the battlefield environment on potential maneuvers.

Provision for More Detailed Terrain/Topography

This question deals with how much information DIVRAS should have access to for depicting detailed terrain/topography over which the battle is occurring. In the workshop version, the digitized background maps carry only outline levels of this data so as to minimize clutter when viewing the combat actions. The concept has been that for further detail the user would refer to Army standard topographic maps at 1:50,000 scale.

This question needs evaluation in the larger context of whether DIVRAS should be interconnected with the intelligence sources which can provide, in machineable form, overlay data for intelligence preparation of the battlefield (IPB). It would be more feasible if this interconnection could be such that the bulk of this data is retained in the intelligence system files and not carried in the DIVRAS permanent files, where it would constitute a significant new requirement on file definition and maintenance functions.

Advantages can be significant if the data handling and storage concerns are managed properly. The most obvious are the use of detailed terrain/topographic data in displaying localized areas at large scale. A user would like the ability to view expanded scenes of mobility corridors and the effect that concentrations of trees, heavy vegetation, soil condition and water table can have on vehicle and troop movement. He would like the ability to view other topographic detail including elevations, slopes, approaches to river crossings, etc.

The IPB concepts appear to offer the essential elements needed to be interoperable with the DIVRAS system. Data of an IPB nature, if accommodated by DIVRAS, should be handled in the form of separately displayable overlays, capable of call-up and removal separate from the basic outline map data.

Air Defense Display

DIVRAS experimentation has included display of friendly maneuver forces in blocking positions and display of friendly artillery positions. Several viewers at workshops commented on the desirability of adding to this repertoire the capability for an air defense display. This is an added function which is manageable within the present concept.

The data for air defense unit disposition, status and location on the ground is already a part of the generalized data base structure. The data for air assets employed in air defense have not been incorporated. Also needed are suitable presentations for airspace data, weapon coverage zones and restriction data.

The approach most compatible with the DIVRAS implementation would be for DIVRAS to store only the current elements needed to create an air defense overlay for the basic maneuver graphics. Changes in this display could be provided remotely through interface with the An/TSQ-73.

Mission Fired Reports

A question often raised in the workshop concerned the follow-up actions permitted by the DIVRAS system with respect to targeting actions taken. One candidate for addition to the targeting application would be the feedback of mission fired reports and some summarization processing between the fire request list (for those targets that the targeting function has requested action on) and the mission fired list. Further, combining this with target damage assessment would render some meaningful possibilities for enhancement of the targeting control function.

The specification for the DIVRAS targeting application calls for mission fired report feedback from the TACFIRE system. extending this to other weapon system interfaces and inclusion of the correct processing support for this feedback information requires further investigation.

Weapon Resource Data Access

An issue raised in the workshop concerned the manner in which the weapon assignment step was performed. Currently the assignment is a basic high-level allocation made to a weapon agent based on area of

reach, areas of restriction and other commander's rules of engagement (with respect to target category and worth) reflected in the fire support element. The assignment algorithm does not automatically consider detailed weapon effects analysis such as might be performed in the Preliminary Target Analysis function of TACFIRE in support of the DTOC/FSE. However, that function would be accessible on a manually initiated basis. The assignment algorithm also does not consider detailed weapon resource data (for example, how many TACAIR sorties might be currently aloft in the vicinity of the target).

The overall DIVRAS concept is to leave the more detailed analysis and assessment capabilities at the weapon systems. This eliminates the significant drawbacks of having to store and continually update within DIVRAS large files of resource parameters and to provide significant processing capability for analyzing such data.

EW Jamming As A Weapon Agent

The workshop sessions identified as an issue the lack of use of electronic warfare as a weapon agent for targeting disposition. The current embodiment of the DIVRAS experiment treats artillery (TACFIRE), tactical air support (TACAIR), and army aviation (attack HELO) as the primary weapon agents to whom targets are passed.

The DIVRAS system could be modified to accommodate EW jamming as a weapon agent if required. The doctrinal issues, however, far exceed the system implementation concerns. The use of EW jamming is often intended as a suppression agent for time dependent deployment in close harmony with the commander's maneuver, defense and fire support plans. It is not as often employed as a means to permanently eliminate a target of worth developed in near real-time.

7.4 PARAMETER/ALGORITHM CHANGES

Target of Interest Work Queue Management

An issue raised in the workshop concerned how the targeting analyst could manipulate the target of interest work queue in periods of peak activity. Currently the system leaves the selection from the queue up to the operator. This means that the operator can select from the queue any target of interest cluster. Currently, the only means he has for making that decision is the colorgraphic target of interest display (displays in blinking mode all target clusters currently in queue). The symbol indicates target subject and the color indicates the method of detection (i.e, PHOTINT, MTIR, ELINT/COMINT).

Suggestions offered during the workshop included a prioritization of the queue in the form of an alphanumerically displayed queue list to further aid the operator in selecting his next targeting work action. Given this, the operator could still override and select out of the queue based on the area, subject and method of detection information inherent in the target of interest graphic. This could be done by placing the graphic cursor on the blinking cluster of his choice rather than lightpenning the line of his choice from the prioritized alphanumeric list. The system could use parameters such as target worth and target category in prioritizing the alphanumeric queue list.

Another approach would be to change the manner of assigning color to the target symbol. For example, if the target symbol was assigned based on target subject (as it is now) but the color for all targets in a target of interest cluster was assigned based on incoming target worth then the operator would have a visual way of selecting the high worth targets out of queue by using the graphic display and cursor.

Inference and Filter Algorithms

During the course of the workshop sessions, the following three issues were raised:

- use of the report reliability parameter in the rules for target filtering
- the ability to expand the filter algorithm
- the ability to infer target permanence

The first issue concerns the fact that the DIVRAS system does not directly utilize the report reliability parameter in the rules for target filtering. The current filter algorithm does, however, permit filtering on report source which is a strong, indirect indicator of report reliability. Report reliability was, during the course of the analysis, considered a weak parameter to filter on because the majority of DIVRAS message inputs came from sensors which tend to report with nearly uniform reliability. The major exception was the enemy activity reports from subordinate echelons which may vary widely. The filter algorithm as specified for the DIVRAS targeting application will, however, flexibly permit the report reliability parameter to be included if required.

The second issue is related to the first and concerned the specific logical combination for each row in the filter algorithm. It was desired that instead of logically "anding" the specific parameters, as indicated in Figure 5.2-5, one should be able to involve other parameters in more complex logical combinations. This is possible and so specified in the DIVRAS targeting application specification.

The third issue questioned how much one could infer about target permanence unless it were reported. The current inference processing algorithm includes a limited amount of direct inferencing for permanence to ensure that moving targets have zero inferred permanence (to ensure correctness for correlation and assignment) and that certain categories of photo reports have specified permanence if not reported. More inference processing can be accomplished by including information from other fields such as subject and target characteristics. Beyond this the key to concluding target permanence lies in the correlation with other closely associated target reports in the data base and inferring from the tactical situation. The specification for the DIVRAS targeting application states a requirement for flexibility in establishing both the inference rule set and the correlation algorithm.

Combat Power Algorithm

This issue deals with the choice of parameters for computing combat power ratio and whether the algorithms' complexity should be extended to include a time dimension. The introduction of the time dimension would allow the user to project enemy and friendly strengths several hours ahead.

The workshop version of the DIVRAS software has a capability to sum-up combat strengths based on counting maneuver battalions inside a selected circle area on the battlefield. The count assumes all battalions at their full TO&E strength. The current algorithm could by modified to accept additional parameters such as (1) a relative effectiveness or power measure, e.g., an armored battalion equates to 1.5 infantry battalions; (2) a measure of a battalion's percent of TO&E strength, etc. Inputs for these computations become increasingly difficult to obtain, particularly after several days of battlefield action. This

suggests that some tradeoff is desirable to achieve to proper balance between information depth and reasonableness in the computation technique.

The algorithm could also be expanded to incorporate a time dimension. The concept is to provide the user with a capability to predict combat strengths in an area at some specified future time. The technique would be straightforward if the user had at his disposal estimates of each force's engagement status and mobility. Using such data the system given a circle area or other geometric shape, could compute each force's maximum movement in a given time and display the likely and worst case combat power ratios. Lacking precise data of this type, an alternate would be for the user to input a single value to reflect a current best estimate of mobility for the enemy maneuver forces in the forward battle areas and cause the system to compute and display the likely and worst case combat power ratios for a future time based on this data.

The choice of algorithm parameters should be based on further analysis and experimentation. For any near term application, the ability should be included in the design to alter the algorithms final form after it has been deployed and initially tested.

Emitter Definitization

This issue deals with how many emitter types should be stored and displayed on the real time emitter overlay. In the DIVRAS workshops to date, emitters have been depicted in two classes--communications emitters and radars. This choice has been based on receipt of essentially raw (unanalyzed) outputs from the DF information processing performed within the capabilities of Trailblazer and Guardrail for enemy radios and of Team Pack and Quick Look for radars. More detailed, analyzed information derived from these sensors is later provided to the DIVRAS data base for

targeting use but not utilized in composing the emitter adjunct displays. Rather the emitter adjunct displays have emphasized the importance of real-time gross activity patterns updated at frequent intervals and interpreted in conjunction with the other adjunct displays of movers and shooters.

The question of providing another level of separation of emitter types needs to be evaluated in terms of how best to achieve the objectives of the maneuvers display function. A tradeoff exists between how much the new detail on emitter classes can help the user versus the perishability of the location patterns as a function of time. The further classification of emitters implies more preprocessing at the sensor ground station and hence some additional time delay before the data can be transferred to DIVRAS. If obtainable on a timely basis, the more detailed classes would permit the user to identify with more precision the structure and tactical mission of some enemy clusters which he could not identify with the present emitter data content.

Standard Format For All Sensors

The DIVRAS application experiment postulated interoperability with external interfaces in such a fashion as to permit non-standardized exchange. The reasons for this included the fact that TOS, TACFIRE and SOTAS are all at some level of definition and development. An issue raised in the workshop concerns the possibility of standardizing at the division level on some form of target data exchange. Although one can translate and format at specified nodes to accommodate non-standardized exchanges, there are programming and processing performance considerations. Standardization would simplify communication interfaces and minimize the number of communication programs at any node to support target data routing. The obvious drawback, however, is how to or whether to change existing or nearly existing systems to accommodate standardization.

7.5 HARDWARE AND HUMAN FACTORS CONSIDERATIONS

Mode Control for the Targeting Application

Comments during the workshop phase raised the issue that even if the system were designed to permit flexible, prompted, on-line change of controllable parameters, the dynamics of battle may not always permit these to be employed in their intended manner. An alternative, human-factored approach was suggested which would permit a set of parameter changes to be pregrouped, stored and invoked in a "mode control" manner. Thus, one could define different parameters for virtually any of the targeting algorithms for different levels of intensity and define several modes corresponding to intensity. The single exception would be the area definitions which would always have to be definable independent of mode. This control approach is included in the DIVRAS targeting application specification.

Movers Overlay Presentation

In the DIVRAS Experiment "movers" were implemented as oval shapes representing up to 10 moving vehicles each and which did not show direction of movement. Questions were raised about each point--why not show a symbol for each moving vehicle (as was the approach in emitters, for example), and why not indicate direction of movement?

Regarding the number of movers to be represented by a single symbol, this issue becomes a tradeoff between the time interval of movers to be shown on the overlay and the number of movers per single symbol. The scenario data represented activity of approximately three enemy divisions (facing one friendly division) during a classic penetration action. The rate of detection of moving targets varied from 6 per minute (i.e., 6 vehicles, not reports) during low activity to 19 per minute during intense activity.

The displays shown in the experiment represented 60 minutes of SOTAS inputs, and represented up to 10 vehicles by one symbol. There were from 50 to 100 symbols on a single overlay of a division area, using this method. Theoretically, the same degree of clutter would be realized by showing 6 minutes of inputs representing each moving vehicle with a single symbol. As battle intensity increases the time interval could be decreased and therefore maintain clutter at a manageable level.

The time interval is an operator controllable variable; more than one symbol type could be included in symbol memory to allow the operator to tune the movers display to the specific situation.

With respect to showing direction of movement, SOTAS normally provides that information and it would appear to add value to the presentation without necessarily introducing clutter. Internal display processing would be complicated by having to directionally orient each symbol on the screen. Time to update the display might be increased, but not significantly.

Capability to Increase/Decrease Scale

The DIVRAS Experimental Facility provides the capability to increase or decrease map scale of the picture being viewed (a "Zoom" capability) in discrete steps. A question was raised about the real value of and need for this capability.

On the maneuver side, the scenario activities required that the division commander frequently focus on each of three major segments of the battle, as well as maintain cognizance of rear echelon enemy actions and status/location of rearward friendly forces as reinforcements. This caused him to move his attention back and forth from an approximate 1:100,000 map scale picture encompassing about a division front (35 x

50 km) to a picture covering roughly twice that. The larger scale presented the best picture for fine tuning enemy unit locations in the frontal areas relative to real time shooter/mover/emitter overlays, whereas the smaller scale was required to see rear echelon activity relative to the front. Additionally, there was an occasional need to go to a larger scale (1:50,000) to examine a particular situation at close range.

In the targeting application, the change scale feature was frequently exercised to "Zoom in" on a specific target cluster of interest in order to declutter the picture and separate the targets for association with other activity in the area.

Distribute Threat Picture

During the DIVRAS workshops, the question was raised about the need for a capability to transmit the commander's maneuver display (threat) scene to other locations equipped for displaying maneuver graphics. Some method for quick communication of data of this type is essential to the concept of DIVRAS. The maneuver display picture, when kept current by frequent updating from the shooter, mover and emitter location reports, represents the division commander's perception of the battlefield including his most imminent trouble spots. Based on his and his staff's perceptions, the commander will raise further questions and/or issue orders to subordinate commands. The most effective way to communicate will be through a common perception graphic picture to which the responsible commanders can address themselves.

The method for scene transmissions need not be resolved at this time. Options include facsimile transmission via telephone or teletype, digital image transmission, or the transmission of the input data so that another command with display creation capability can construct the same digital image.

Large Screen Display

The need for a large screen color display was questioned.

The need, of course, depends on the operational environment into which DIVRAS applications are deployed and whether or not group viewing is a frequent requirement. If the assumptions made in the DIVRAS study about the need for a high degree of mobility (and therefore relatively small staff) are correct, the requirement for group viewing would seem to be minimal. Provision for multiple symbol sizes within the DIVRAS capability facilitates comprehension of a standard size graphic terminal by small groups of viewers. Also, the transferability of screen frames between analysts lessens the need for common simultaneous viewing.

Black and White Versus Color

The question was raised as to the real need for color.

The DIVRAS experimentation facility was equipped with black and white as well as color terminals, so the ability to directly contrast was inherent throughout the experiment. On the maneuver display the use of the basic three colors for separation of enemy forces, friendly forces, and background information was felt by operators and a large majority of viewers to be extremely helpful in simplifying presentation of the overall battle situation. Not only is it useful in summarizing large amounts of information (as for use by the commander) but it is also effective in target analysis for quickly separating different target types and their respective data sources in dense clusters. Where speed of comprehension is important, color can be very effective.

The requirement for color does pose significant technology challenges in an operational environment. However, experimentation indicated that a minimum three color presentation was needed for the targeting and maneuver applications to be effective.

APPENDIX A

SCENARIO TARGET LIST

1. Tank Regiment - Two Lead Battalions

a. Moving Targets

4 Groups of 10 tanks per group
3 Groups of 3 tanks per group
1 Group of 6 APC's per group
1 Group of 4 APC's and 1 tank per group
2 Groups of 9 tanks
2 Groups of 1 tank and 1 APC per group
13

b. Shooters

c. Emitters

8 Radios
3 Radars

2. Tank Regiment - Second Echelon Battalion

a. Moving Targets

3 Groups of 11 tanks and 1 APC per group
1 Group of 10 APC per group
3 Groups of 7 trucks per group
7

b. Shooters

c. Emitters

42 Radios

0 Radars

3. Tank Regiment - CP

a. Moving Targets

1 Group of 2 tanks per group
1 Group of 2 tanks per group
1 Group of 8 APC's per group
1 Group of 3 APC's per group
1 Group of 2 APC's per group
1 Group of 4 APC's per group
1 Group of 7 trucks per group
4 Groups of 10 trucks per group
1 Group of 2 trucks per group
3 Groups of 12 trucks per group
1 Group of 17 trucks per group
1 Group of 13 trucks per group
1 Group of 10 trucks per group

18

b. Shooters

c. Emitters

80 Radios

0 Radars

4. Tank Regiment - Two Lead Plus Second Echelon Battalion

a. Moving Targets

4	Groups of 10 tanks per group
3	Groups of 3 tanks per group
1	Group of 6 APC's per group
1	Group of 4 APC's, 1 tank per group
2	Groups of 9 tanks per group
2	Groups of 1 APC, 1 tank per group
3	Groups of 11 tanks, 1 APC per group
1	Group of 10 APC's per group
3	Groups of 7 trucks per group
20	

b. Shooters

c. Emitters

126	Radios
0	Radars

5. Motorized Rifle Regiment - Two Lead Battalions

a. Moving Targets

4	Groups of 3 tanks per group
4	Groups of 7 APC's per group
2	Groups of 3 tanks per group
2	Groups of 7 APC's per group
2	Groups of 3 Self-Propelled Artillery per group
14	

b. Shooters

c. Emitters

124 Radios

0 Radars

6. Motorized Rifle Regiment - Second Echelon Battalion

a. Moving Targets

3 Groups of 10 APC's per group

3 Groups of 3 tanks per group

6 Groups of 11 trucks per group

12

b. Shooters

c. Emitters

62 Radios

0 Radars

7. Motorized Rifle Regiment - CP

a. Moving Targets

1 Group of 3 tanks per group

1 Group of 4 trucks and 2 APC's per group

2 Groups of 9 trucks per group

1 Group of 8 trucks per group

3 Groups of 10 trucks per group

1 Group of 6 trucks per group

3 Groups of 16 trucks per group

1 Group of 13 trucks per group

1 Group of 4 trucks per group

1 Group of 10 trucks per group

15

b. Shooters

c. Emitters

95 Radios

0 Radars

8. Motorized Rifle Regiment - Two Lead Plus Second Echelon Battalion

a. Moving Targets

4 Groups of 3 tanks per group
4 Groups of 7 APC's per group
2 Groups of 3 tanks per group
2 Groups of 7 APC's per group
2 Groups of 3 Self-Propelled Artillery per group
3 Groups of 10 APC's per group
3 Groups of 3 tanks per group
6 Groups of 11 tanks per group

26

b. Shooters

c. Emitters

186 Radios

0 Radars

9. Tank Divisions - Without Artillery Regiment, SA-6 Regiment, FROG Battalion, Motorized Rifle Battalion

a. Moving Targets

3	Groups of 11 trucks per group
7	Groups of 5 trucks, 3 APC's, 1 tank per group
4	Groups of 14 trucks, 1 APC per group
10	Groups of 12 trucks, 1 APC per group
10	Groups of 9 trucks per group
5	Groups of 11 trucks per group
5	Groups of 10 trucks per group
1	Group of 2 trucks, 5 APC's per group
1	Group of 15 trucks per group
3	Groups of 72 trucks, 35 APC's, 15 tanks per group
9	Groups of 53 trucks, 8 APC's, 32 tanks per group
58	

b. Shooters

6	122 mm Howitzers
16	SA-9
59	SA-7
81	

c. Emitters

1332	Radios
0	Radars

10. Tank Division - Artillery Regiment

a. Moving Targets

3 Groups of 61 trucks, 1 APC per group

b. Shooters

54 122mm Howitzers

c. Emitters

93 Radios
3 Pole Dish Radars
1 Pork Trough Radar
1 Small yawn Radar
1 Bread Bin Radar
1 End Tray Radar

11. Tank Division - SA-6 Regiment (5 Firing Batteries per Regiment)

a. Moving Targets

5 Groups of 8 trucks per group
5 Groups of 4 Transporter-Erector-Launcher (TEL) per group
10

b. Shooters

20 TELs

c. Emitters

45 Radios
2 Long Track Radars
5 Straight Flush Radars
1 Thin Skin Radar

12. Tank Division - FROG Battalion (Two Batteries per Battalion)

a. Moving Targets

3 Groups of 11 trucks, 2 APC's per group

b. Shooters

4 FROG Launchers

c. Emitters

30 Radios
2 Bread Bin Radars

13. Tank Division - CP

a. Moving Targets

3 Groups of 11 trucks per group
7 Groups of 5 trucks, 3 APC's, 1 tank per group
9 Groups of 20 trucks per group
6 Groups of 6 trucks, 1 APC per group
6 Groups of 14 trucks per group
12 Groups of 10 trucks per group
4 Groups of 14 trucks, 1 APC per group
10 Groups of 12 trucks, 1 APC per group
10 Groups of 9 trucks per group
5 Groups of 11 trucks per group
20 Groups of 20 trucks per group
5 Groups of 10 trucks per group
1 Group of 2 trucks, 5 APC's per group
1 Group of 15 trucks per group
4 Groups of 11 trucks per group

103

b. Shooters

4 SA-7
54 122mm Howitzers
4 FROG Launchers
18 122mm Rocket Launchers
80

c. Emitters

462 Radios
27 Radars

14. Tank Division - Artillery Battery

a. Moving Targets

1 Group of 18 trucks per group

b. Shooters

6 122mm Howitzers

c. Emitters

11 Radios
1 Radar

15. Motorized Rifle Division - CP (Without Artillery Regiment)

a. Moving Targets

3	Groups of 11 trucks per group
7	Groups of 5 trucks, 3 APC's, 1 tank per group
6	Groups of 6 trucks, 1 APC per group
6	Groups of 15 trucks per group
3	Groups of 7 trucks per group
2	Groups of 20 trucks, 1 APC per group
6	Groups of 13 trucks per group
4	Groups of 18 trucks, 1 APC per group
7	Groups of 23 trucks, 1 APC per group
6	Groups of 16 trucks per group
5	Groups of 11 trucks per group
20	Groups of 20 trucks per group
5	Groups of 5 trucks per group
1	Group of 5 APC's per group
1	Group of 15 APC's per group
2	Groups of 20 trucks, 1 APC per group
84	

b. Shooters

4	SA-7
4	FROG
18	122mm Rocket Launchers
26	

c. Emitters

413	Radios
11	Radars

16. Motorized Rifle Division - Artillery Battery

a. Moving Targets

1 Group of 18 trucks

b. Shooters

6 122mm Howitzers

c. Emitters

11 Radios
1 Radar

17. Tank Division - Division Supply Point

1 Tank Depot and Repair Shop
1 Artillery and Small Arms Depot
1 Ammunitions Dump
1 POL Dump
1 Rations Dump
1 Field Bakery
1 Shower, Laundry and Water Point

7

18. Motorized Rifle Regiment - Regiment Supply Point (Division Supply to Regiment)

a. Moving Targets (the Division Motor Transport Battalion)

4 Groups of 25 trucks per group
5 Groups of 20 trucks per group

9

b. Fixed Targets

1 POL Dump
1 Ammunitions Dump
1 Rations Dump
1 Motor Vehicle and Tank Repair
1 Weapons Repair
5

19. Tank Regiment - Regiment Supply Point (Division Supply to Regiment)

a. Moving Targets (the Division Motor Transport Battalion

4 Groups of 25 trucks per group
5 Groups of 20 trucks per group
9

b. Fixed Targets

1 POL Dump
1 Ammunition Dump
1 Rations Dump
1 Motor Vehicle and Tank Repair
1 Weapons Repair
5

20. Tank Division - Assembly Point (Motor Transport Regiment used to Populate)

a. Moving Targets

2 Groups of 13 trucks per group
20 Groups of 18 trucks per group
1 Group of 27 trucks per group
1 Group of 20 trucks per group
9 Groups of 21 POL trucks per group
18 Groups of 20 trucks per group
3 Groups of 10 trucks per group
54

b. Emitters

50 Radios
0 Radars

21. Army Group Artillery Assembly Point - (Artillery Division used to Populate)

a. Moving Targets

1 Group of 30 trucks per group
1 Group of 28 trucks per group
1 Group of 37 trucks per group
1 Group of 14 trucks per group
1 Group of 15 trucks per group
1 Group of 10 POL trucks per group
1 Group of 21 tractors per group
1 Group of 26 trailers per group
12

b. Shooters

18 100mm Antitank Guns
36 130mm Field Guns
36 152mm Howitzers

c. Emitters

75 Radios
6 Pole Dish Radars
1 Pork Trough Radars
1 Bread Bin Radars

22. Tank Division - CP (Without Artillery Regiment)

a. Moving Targets

3	Groups of 11 trucks per group
7	Groups of 5 trucks, 3 APC's, 1 tank per group
6	Groups of 6 trucks, 1 APC, per group
6	Groups of 14 trucks per group
12	Groups of 10 trucks per group
4	Groups of 14 trucks, 1 APC per group
10	Groups of 12 trucks, 1 APC per group
10	Groups of 9 trucks per group
5	Groups of 11 trucks per group
20	Groups of 20 trucks per group
5	Groups of 10 trucks per group
1	Group of 2 trucks, 5 APC's per group
1	Group of 15 trucks per group
4	Groups of 11 trucks per group
94	

b. Shooters

4	SA-7
4	FROG Launchers
18	122mm Rocket Launchers
26	

c. Emitters

369	Radios
20	Radars

APPENDIX B

SCENARIO TARGET TIME HISTORIES

UNITS	64TR Lead Bns	64TR 2d ECH	64TR CP	65TR LD BNS	65TR 2d ECH	65TR CP	204MRR Lead Bns	204MRR 2d ECH	204MRR CP	33 FTR Lead Bns	33 FTR CP	103 TD CP	80 FTD ARTY UNITS	101 TD ARTY UNITS
Time														
____	PL230744	→	→	PL200754	PL215759	PL215759	PL200724	PL215724	PL215729	PL255739	→	PL315759	PL410734 PL415714 PL380694 PL400694 PL430699 PL390734 PL395714	PL420829 PL420829 PL420814 PL375834 PL310804 PL325804 PL380809
0400	PL220744	→												
0500	PL210734	→												
____	PL140734													
0600	PL140734	PL210734		PL200764	PL215754	PL215759	PL200724	PL215724	PL215729					
____														
0700			PL230744					PL205724		PL255739				
____														
0800					PL210767									
____			PL205734		PL190754					PL210734				
0900	PL160724	PL190734		PL185754	PL190754	PL215759	PL180714	PL180714	PL215729		PL255739	PL315759	Same as Above	Same as Above

ENEMY UNIT MGR LOCATIONS - SUBSCENARIO 1

SUBSCENARIO 1

TIME \ UNIT TYPE	64 TANK REGIMENT - LEAD BATTALIONS					64 TANK REGIMENT - 2ND ECHELON				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	33	13	20	84	0	18	7	11	42	0
0400 -	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	33	13	20	84	0	18	7	11	42	0

SUBSCENARIO 1

TIME \ UNIT TYPE	64 TANK REGIMENT - CP					65 TANK REGIMENT - LEAD BATTALIONS				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	30	0	12	80	0	33	0	20	84	0
0400 -										
-										
0500 -										
-										
0600 -							13			
-										
0700 -		18								
-										
0800 -										
-										
0900 -	30	18	12	80	0	33	13	20	84	0

SUBSCENARIO 1

TIME \ UNIT TYPE	65 TANK REGIMENT - 2nd ECHELON					65 TANK REGIMENT - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	18	7	11	42	0	30	0	12	80	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-		0								
0900 -	18	0	11	42	0	30	0	12	80	0

SUBSCENARIO 1

TIME \ UNIT TYPE	204 MRR - LEAD BATTALIONS					204 MRR - 2ND ECHELON				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	32	0	18	124	0	21	0	9	62	0
0400 -										
-										
0500 -										
-										
0600 -		14					12			
-										
0700 -										
-										
0800 -										
-										
0900 -	32	14	18	124	0	21	12	9	62	0

SUBSCENARIO 1

UNIT TYPE / TIME	204 MRR - CP					33 F TANK REGIMENT - LEAD BATTALIONS				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	23	00	8	95	0	33	0	20	84	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -							13			
-										
0800 -										
-										
0900 -	23	0	8	95	0	33	13	20	84	0

SUBSCENARIO 1

TIME \ UNIT TYPE	33 F TANK REGIMENT - CP					103 TANK DIVISION - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	30	0	12	80	0	183	0	80	462	27
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	30	0	12	80	0	183	0	80	462	27

SUBSCENARIO 1

TIME \ UNIT TYPE	80F TANK DIVISION - ARTILLERY UNITS (1)					101 TANK DIVISION - ARTILLERY UNITS (1)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 1

TIME \ UNIT TYPE	80F TANK DIVISION - ARTILLERY UNITS (2)					101 TANK DIVISION - ARTILLERY UNITS (2)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 1

TIME \ UNIT TYPE	80F TANK DIVISION - ARTILLERY UNITS (3)					101 TANK DIVISION - ARTILLERY UNITS (3)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 1

TIME \ UNIT TYPE	80F RANK DIVISION - ARTILLERY UNITS (4)					101 TANK DIVISION - ARTILLERY UNITS (4)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 1

TIME \ UNIT TYPE	80F TANK DIVISION - ARTILLERY UNITS (5)					101 TANK DIVISION - ARTILLERY UNITS (5)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 1

TIME \ UNIT TYPE	80F TANK DIVISION - ARTILLERY UNITS (6)					101 TANK DIVISION - ARTILLERY UNITS (6)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 1

TIME \ UNIT TYPE	80F TANK DIVISION - ARTILLERY UNITS (7)					101 TANK DIVISION - ARTILLERY UNITS (7)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

Ft.Hood	212 TR Lead Bns	212 TR 2nd Ech	212 CP	440 MRR Lead Bns	440 MRR 2nd Ech	440 MRR CP	220 TR	220 TR CP	213 TR	213 TR CP	80 FTD CP					
Time																
0400	PL262689	PL290690	PL290697	PL292675	PL322685	PL322680	PL303729	PL303729	PL340719	PL340719	PL355739					
0500																
0600	PL258686			PL292675												
0700	PL247686	PL295690		PL291673												
				PL280664	PL322685											
0800	PL231677	PL264680		PL250658 PL241657					PL340719							
				PL241659	PL281670											
0900									PL300679							

ENEMY UNIT MGR LOCATIONS - SUBSCENARIO 2

SUBSCENARIO 2

TIME \ UNIT TYPE	212 TANK REGIMENT - LEAD BATTALIONS					212 TANK REGIMENT - 2ND ECHELON				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	33	13	20	84	0	18	7	11	42	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-		13					7			
0900 -	33	0	20	84	0	18	0	11	42	0

SUBSCENARIO 2

TIME \ UNIT TYPE	212 TANK REGIMENT - CP					440 MRR - LEAD BATTALIONS				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	30	0	12	80	0	32	14	18	124	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-							14			
0900 -	30	0	12	80	0	32	0	18	124	0

SUBSCENARIO 2

TIME \ UNIT TYPE	440 MRR - 2ND ECHELON					440 MRR - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	21	12	9	62	0	23	0	8	95	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-		12								
0900 -	21	0	9	62	0	23	0	8	95	0

SUBSCENARIO 2

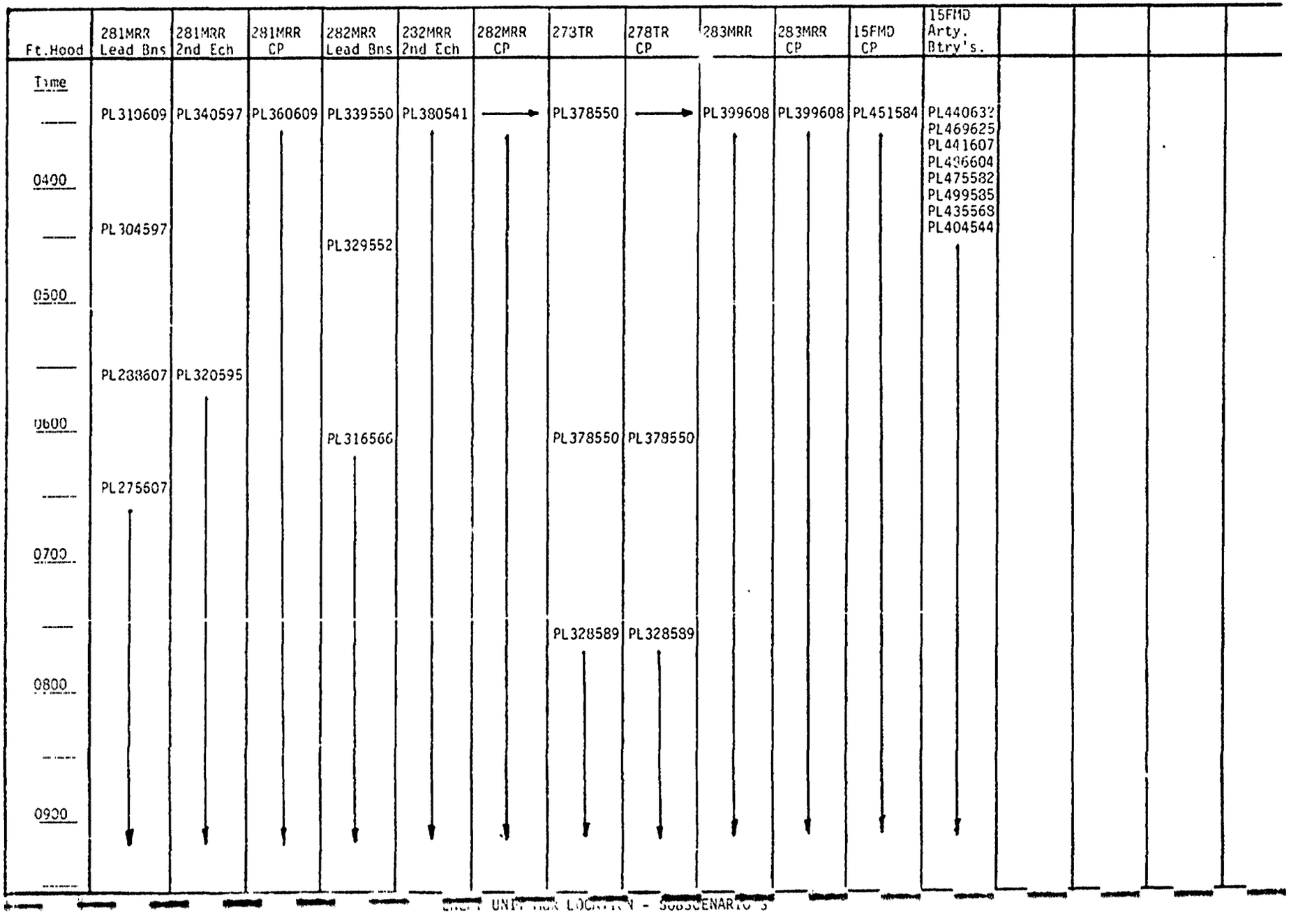
TIME \ UNIT TYPE	220 TANK REGIMENT - (TWO LEAD BATTALIONS & 2ND ECHELON BATTALION)					220 TANK REGIMENT - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	51	0	31	84	0	30	0	12	80	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	51	0	31	84	0	30	0	12	80	0

SUBSCENARIO 2

TIME \ UNIT TYPE	213 TANK REGIMENT - (TWO LEAD BATTALIONS & 2ND ECHELON BATTALION)					213 TANK REGIMENT - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	51	0	31	84	0	30	0	12	80	0
0400 -										
0500 -										
0600 -										
0700 -										
0800 -		13								
0900 -	51	13	31	84	0	30	0	12	80	0

SUBSCENARIO 2

TIME \ UNIT TYPE	80 FTD - CP									
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	120	0	26	369	20					
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	120	0	26	369	20					



UNIT FOR LOCATION - 308SCENARIO 3

SUBSCENARIO 3

TIME \ UNIT TYPE	281 MRR - LEAD BATTALIONS					281 MRR - 2ND ECHELON				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	32	14	18	124	0	21	12	9	62	0
0400 -										
-										
0500 -										
-							0			
0600 -										
-		0								
0700 -										
-										
0800 -										
-										
0900 -	32	0	18	124	0	21	0	9	62	0

SUBSCENARIO 3

TIME \ UNIT TYPE	281 MRR - CP					282 MRR - LEAD BATTALIONS				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	23	0	8	95	0	32	14	18	124	0
0400 -										
-										
0500 -										
-							0			
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	23	0	8	95	0	32	0	18	124	0

SUBSCENARIO 3

TIME \ UNIT TYPE	282 MRR - 2ND ECHELON					282 MRR - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	21	0	9	62	0	23	0	8	95	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	21	0	9	62	0	23	0	8	95	0

SUBSCENARIO 3

TIME \ UNIT TYPE	278 TANK REGIMENT - (LEAD BATTALIONS & 2ND ECHELON BATTALION)					278 TANK REGIMENT - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	51	0	31	126	0	30	0	12	80	0
0400 -										
-										
0500 -										
-										
0600 -										
-		20					18			
0700 -										
-		0					0			
0800 -										
-										
0900 -	51	0	31	126	0	30	0	12	80	0

SUBSCENARIO 3

TIME \ UNIT TYPE	283 MRR - (LEAD BATTALIONS & 2ND ECHELON BATTALION)					283 MRR - CP				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	53	0	27	186	0	23	0	8	95	0
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	53	0	27	186	0	23	0	8	95	0

SUBSCENARIO 3

TIME \ UNIT TYPE	15 F MOTORIZED DIVISION - CP									
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	110	0	26	413	11					
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	110	0	26	413	11					

SUBSCENARIO 3

TIME \ UNIT TYPE	15 F MOTORIZED DIVISION - ARTILLERY BATTERY (1)					15 F MOTORIZED DIVISION - ARTILLERY BATTERY (2)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 3

TIME \ UNIT TYPE	15 F MOTORIZED DIVISION - ARTILLERY BATTERY (3)					15 F MOTORIZED DIVISION - ARTILLERY BATTERY (4)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 3

TIME \ UNIT TYPE	15 F MOTORIZED DIVISION - ARTILLERY BATTERY (5)					15 F MOTORIZED DIVISION - ARTILLERY BATTERY (6)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

SUBSCENARIO 3

TIME \ UNIT TYPE	15 F MOTORIZED DIVISION - ARTILLERY BATTERY (7)					15 F MOTORIZED DIVISION - ARTILLERY BATTERY (8)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	7	0	6	11	1	7	0	6	11	1
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -	7	0	6	11	1	7	0	6	11	1

Ft.Hood	102 TD	102 TD Arty.	102 TD SA.6 Rgt.	102 TD FROG Bn	206 TD	206 TD Non-Div. Arty.	206 TD SA.6 Btry's	206 TD FROG Bn (Att)		102 TD Div.Sup. Pt.	206 TD Div.Sup. Pt.	11 MRR Sup.Pt.	66 TR Rgt.Sup.	102 TD Assembly Point	Army Gp. Arty. Assembly Point	
Time																
____	PL815714	PL815711	PL815714	PL815714	PL940354	PL815654	PL680774	PL815654					PL405875	PL815714	PL815654	
						PL752604		PL815654								
0400										PL650834						
		PL815714		PL815714												
						PL672558		PL762604			PL620594					
____		PL722719			PL765432							PL450534	PL405875			
				PL722719		PL642691		PL739670								
0500			PL815714													
		PL669878														
____	PL815714					PL560592										
								PL598660								
			PL722719	PL529798												
		PL529798			PL642614											
0600	PL722719															
						PL410654	PL680774	PL530584								
		PL400755														
____	PL590784		PL529798				PL660745									
		PL350784		PL465775												
					PL612571		PL700729									
				PL440794												
0700			PL400755		PL575581											
							PL618689									
____	PL519819															
							PL609709									
0800			PL380814													
							PL472695									
____							PL430624									
0900	PL440864				PL470564											

NOTE: Most intermediate points are on roads or intersections.

ENEMY UNIT MGR LOCATIONS - SUBSCENARIO 5.

SUBSCENARIO 5

UNIT TYPE / TIME	102 TANK DIVISION					102 TANK DIVISION - ARTILLERY REGIMENT				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330	64	0	6	1332	0	57	0	54	93	7
0400							3			
0500		58								
0600							0			
0700										
0800										
0900	64	58	6	1332	0	57	0	54	93	7

SUBSCENARIO 5

TIME \ UNIT TYPE	102 TANK DIVISION - SA-6 REGIMENT					102 TANK DIVISION - FROG BATTALION				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	30	0	20	45	8	7	0	4	30	2
0400 -							3			
0500 -		10								
0600 -										
0700 -							0			
0800 -		0								
0900 -	30	0	20	45	8	7	0	4	30	2

SUBSCENARIO 5

TIME \ UNIT TYPE	206 TANK DIVISION					206 TANK DIVISION - ARTILLERY REGIMENT				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330	64	58	6	1332	0	57	3	54	93	7
0400										
0500										
0600							0			
0700										
0800										
0900	64	58	6	1332	0	57	0	54	93	7

SUBSCENARIO 5

TIME \ UNIT TYPE	206 TANK DIVISION - SA-6 BATTERIES (5)					206 TANK DIVISION - FROG BATTALION (ATTACHED)				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -	25	0	20	45	8	7	3	4	30	2
0400 -										
0500 -										
0600 -		10					0			
0700 -										
0800 -										
-		0								
0900 -	25	0	20	45	8	7	0	4	30	2

SUBSCENARIO 5

TIME \ UNIT TYPE	11 MRR - SUPPLY POINT					66 TANK REGIMENT - REGIMENT SUPPLY POINT				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -										
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -										

SUBSCENARIO 5

TIME \ UNIT TYPE	102 TANK DIVISION - DIVISION SUPPLY POINT					206 TANK DIVISION - DIVISION SUPPLY POINT				
	NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS		NUMBER OF TARGETS	NUMBER OF MOVING TARGETS	NUMBER OF SHOOTING TARGETS	NUMBER OF EMITTERS	
				RADIOS	RADARS				RADIOS	RADARS
0330 -										
0400 -										
-										
0500 -										
-										
0600 -										
-										
0700 -										
-										
0800 -										
-										
0900 -										

APPENDIX C

REPRESENTATIVE TARGET/TIME

HISTORIES RELATED TO THE SOTAS SENSOR

C-1. 0400

TIME - 0400-0500

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME	DETECTION TIME
1	1-4	10 Tanks	Two Lead Battalions - 64 TR	439
1	5-7	3 Tanks	Two Lead Battalions - 64 TR	410
1	8	6 APC's	Two Lead Battalions - 64 TR	
1	9	4 APC's, 1 Tank	Two Lead Battalions - 64 TR	405
1	10-11	9 Tanks	Two Lead Battalions - 64 TR	
1	12-13	1 APC, 1 Tank	Two Lead Battalions - 64 TR	
1	14-16	11 Tanks, 1 APC	2nd Echelon - 64 TR	
1	17	10 APC's	2nd Echelon - 64 TR	
1	18-20	7 Trucks	2nd Echelon - 64 TR	431, 441, 455
1	21-23	11 Tanks, 1 APC	2nd Echelon - 65 TR	
1	24	10 APC's	2nd Echelon - 65 TR	
1	25-27	7 Tanks	2nd Echelon - 65 TR	
2	1-4	10 Tanks	Two Lead Battalions - 212 TR	
2	5-7	3 Tanks	Two Lead Battalions - 212 TR	409, 429
2	8	6 APC's	Two Lead Battalions - 212 TR	
2	9	4 APC's, 1 Tank	Two Lead Battalions - 212 TR	
2	10-11	9 Tanks	Two Lead Battalions - 212 TR	
2	12-13	1 APC, 1 Tank	Two Lead Battalions - 212 TR	411
2	14-16	11 Tanks, 1 Apc	2nd Echelon - 212 TR	
2	17	10 APC's	2nd Echelon - 212 TR	426
2	18-20	7 Trucks	2nd Echelon - 212 TR	433
2	21-24	3 Tanks	Two Lead Battalions - 440 MRR	421
2	25-28	7 APC's	Two Lead Battalions - 440 MRR	400, 404
2	29-30	3 Tanks	Two Lead Battalions - 440 MRR	
2	31-32	7 APC's	Two Lead Battalions - 440 MRR	
2	33-34	3 Self-Propelled Artillery	Two Lead Battalions - 440 MRR	
2	35-37	10 APC's	2nd Echelon - 440 MRR	433
2	38-40	3 Tanks	2nd Echelon - 440 MRR	
2	41-46	11 Trucks	2nd Echelon - 440 MRR	
3	1-4	3 Tanks	Two Lead Battalions - 281 MRR	413, 457
3	5-8	7 APC's	Two Lead Battalions - 281 MRR	
3	9-10	3 Tanks	Two Lead Battalions - 281 MRR	
3	11-12	7 APC's	Two Lead Battalions - 281 MRR	
3	13-14	3 Self-Propelled Artillery	Two Lead Battalions - 281 MRR	
3	15-17	10 APC's	2nd Echelon - 281 MRR	
3	18-20	3 Tanks	2nd Echelon - 281 MRR	
3	21-26	11 Trucks	2nd Echelon - 281 MRR	444, 445, 456
3	27-30	3 Tanks	Two Lead Battalions - 282 MRR	
3	31-34	7 APC's	Two Lead Battalions - 282 MRR	410, 422
3	35-36	3 Tanks	Two Lead Battalions - 282 MRR	
3	37-38	7 APC's	Two Lead Battalions - 282 MRR	
3	39-40	3 Self-Propelled Artillery	Two Lead Battalions - 282 MRR	404
5	1-2	20 Trucks to 11 MRR Supply Pt	206 TD - Motor Transport Bn	409
5	3	25 Trucks to 11 MRR Supply Pt	206 TD - Motor Transport Bn	
5	4	20 Trucks to 66 TR Supply Pt	102 TD - Motor Transport Bn	

TIME - 0530-0600

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT BASE	DETECTION TIME
1	1-4	10 Tanks	Two Lead Battalions - 64 TR	
1	5-7	3 Tanks	Two Lead Battalions - 64 TR	506, 529
1	8	6 APC's	Two Lead Battalions - 64 TR	
1	9	4 APC's, 1 Tank	Two Lead Battalions - 64 TR	
1	10-11	9 Tanks	Two Lead Battalions - 64 TR	
1	12-13	1 APC, 1 Tank	Two Lead Battalions - 64 TR	
1	14-16	11 Tanks, 1 APC	2nd Echelon - 64 TR	532
1	17	10 APC's	2nd Echelon - 64 TR	
1	18-20	7 Trucks	2nd Echelon - 64 TR	512
1	21-23	11 Tanks, 1 APC	2nd Echelon - 64 TR	
1	24	10 APC's	2nd Echelon - 64 TR	503
1	25-27	7 Trucks	2nd Echelon - 64 TR	514
2	1-4	10 Tanks	Two Lead Battalions - 212 TR	504
2	5-7	3 Tanks	Two Lead Battalions - 212 TR	
2	8	6 APC's	Two Lead Battalions - 212 TR	
2	9	4 APC's, 1 Tank	Two Lead Battalions - 212 TR	
2	10-11	9 Tanks	Two Lead Battalions - 212 TR	
2	12-13	1 APC, 1 Tank	Two Lead Battalions - 212 TR	509
2	14-16	11 Tanks, 1 APC	2nd Echelon - 212 TR	537, 534
2	17	10 APC's	2nd Echelon - 212 TR	
2	18-20	7 Trucks	2nd Echelon - 212 TR	
2	21-24	3 Tanks	Two Lead Battalions - 440 ISR	521, 529
2	25-26	7 APC's	Two Lead Battalions - 440 ISR	
2	29-30	3 Tanks	Two Lead Battalions - 440 ISR	
2	31-32	7 APC's	Two Lead Battalions - 440 ISR	
2	33-34	3 Self-Propelled Artillery	Two Lead Battalions - 440 ISR	
2	35-37	10 APC's	2nd Echelon - 440 ISR	
2	38-40	3 Tanks	2nd Echelon - 440 ISR	
2	41-46	11 Trucks	2nd Echelon - 440 ISR	524, 547
3	1-4	3 Tanks	Two Lead Battalions - 281 ISR	512
3	5-8	7 APC's	Two Lead Battalions - 281 ISR	524
3	9-10	3 Tanks	Two Lead Battalions - 281 ISR	
3	11-12	7 APC's	Two Lead Battalions - 281 ISR	
3	13-14	3 Self-Propelled Artillery	Two Lead Battalions - 281 ISR	
3	15-17	10 APC's	2nd Echelon - 281 ISR	536
3	18-20	3 Tanks	2nd Echelon - 281 ISR	
3	21-24	3 Tanks	Two Lead Battalions - 282 ISR	543
3	25-27	7 APC's	Two Lead Battalions - 282 ISR	557
5	1-3	61 Trucks, 1 APC	206 TD - Artillery Regiment	
5	4-5	11 Trucks, 2 APC's	206 TD - FROG Battalion	
5	6-7	20 Trucks from 11 ISR Supply	206 TD - Motor Transport Bn	522, 559
5	8	25 Trucks from 11 ISR Supply	206 TD - Motor Transport Bn	
5	9-10	20 Trucks to 11 ISR Supply	206 TD - Motor Transport Bn	
5	11	25 Trucks to 11 ISR Supply	206 TD - Motor Transport Bn	
5	12	20 Trucks from 66 TR Supply	102 TD - Motor Transport Bn	553
5	13-14	20 Trucks to 66 TR Supply	102 TD - Motor Transport Bn	
5	15	25 Trucks to 66 TR Supply	102 TD - Motor Transport Bn	

TIME - 0600-0700

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME	DETECTION TIME
1	1-4	10 Tanks	Two Lead Battalions - 64 TR	610
1	5-7	3 Tanks	Two Lead Battalions - 64 TR	
1	8	6 APC's	Two Lead Battalions - 64 TR	620
1	9	4 APC's, 1 Tank	Two Lead Battalions - 64 TR	
1	10-11	9 Tanks	Two Lead Battalions - 64 TR	645
1	12-13	1 APC, 1 Tank	Two Lead Battalions - 64 TR	
1	14-16	11 Tanks, 1 APC	2nd Echelon - 64 TR	
1	17	10 APC's	2nd Echelon - 64 TR	
1	18-20	7 Trucks	2nd Echelon - 64 TR	609, 610
1	21-24	10 Tanks	Two Lead Battalions - 65 TR	631, 646
1	25-27	3 Tanks	Two Lead Battalions - 65 TR	653
1	28	6 APC's	Two Lead Battalions - 65 TR	
1	29	4 APC's, 1 Tank	Two Lead Battalions - 65 TR	
1	30-31	9 Tanks	Two Lead Battalions - 65 TR	609
1	32-33	1 APC, 1 Tank	Two Lead Battalions - 65 TR	
1	34-36	11 Tanks, 1 APC	2nd Echelon - 65 TR	
1	37	10 APC's	2nd Echelon - 65 TR	
1	38-40	7 Trucks	2nd Echelon - 65 TR	
1	41-44	3 Tanks	Two Lead Battalions - 204 MRR	650
1	45-48	7 APC's	Two Lead Battalions - 204 MRR	658
1	49-50	3 Tanks	Two Lead Battalions - 204 MRR	
1	51-52	7 APC's	Two Lead Battalions - 204 MRR	
1	53-54	3 Self-Propelled Artillery	Two Lead Battalions - 204 MRR	
1	55-57	10 APC's	2nd Echelon - 204 MRR	
1	58-60	3 Tanks	2nd Echelon - 204 MRR	
1	61-66	11 Trucks	2nd Echelon - 204 MRR	
2	1-4	10 Tanks	Two Lead Battalions - 212 TR	
2	5-7	3 Tanks	Two Lead Battalions - 212 TR	
2	8	6 APC's	Two Lead Battalions - 212 TR	
2	9	4 APC's, 1 Tank	Two Lead Battalions - 212 TR	
2	10-11	9 Tanks	Two Lead Battalions - 212 TR	
2	13-13	1 APC, 1 Tank	Two Lead Battalions - 212 TR	
2	14-16	11 Tanks, 1 APC	2nd Echelon - 212 TR	611
2	17	10 APC's	2nd Echelon - 212 TR	
2	18020	7 Trucks	2nd Echelon - 212 TR	635
2	21-24	3 Tanks	Two Lead Battalions - 440 MRR	602
2	25-28	7 APC's	Two Lead Battalions - 440 MRR	
2	29-30	3 Tanks	Two Lead Battalions - 440 MRR	604
2	31-32	7 APC's	Two Lead Battalions - 440 MRR	649
2	33-34	3 Self-Propelled Artillery	Two Lead Battalions - 440 MRR	612, 658
2	35-37	10 APC's	2nd Echelon - 440 MRR	
2	38-40	3 Tanks	2nd Echelon - 440 MRR	
2	41-46	11 Trucks	2nd Echelon - 440 MRR	605, 631, 659

TIME - 0600-0700

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME	DETECTION TIME
3	1	7 APC's	Two Lead Battalions - 281 MRR	
3	2-3	3 Tanks	Two Lead Battalions - 281 MRR	
3	4-6	7 APC's	Two Lead Battalions - 281 MRR	
3	5-7	3 Self-Propelled Artillery	Two Lead Battalions - 281 MRR	
3	8-11	10 Tanks	Two Lead Bn, 2nd Echelon - 273 TR	612
3	12-14	3 Tanks	Two Lead Bn, 2nd Echelon - 273 TR	
3	15	6 APC's	Two Lead Bn, 2nd Echelon - 273 TR	
3	16	4 APC's, 1 Tank	Two Lead Bn, 2nd Echelon - 273 TR	
3	17-18	9 Tanks	Two Lead Bn, 2nd Echelon - 273 TR	
3	19-20	1 APC, 1 Tank	Two Lead Bn, 2nd Echelon - 273 TR	
3	21-23	11 Tanks, 1 APC	Two Lead Bn, 2nd Echelon - 273 TR	640
3	24	10 APC's	Two Lead Bn, 2nd Echelon - 273 TR	
3	25-27	7 Trucks	Two Lead Bn, 2nd Echelon - 273 TR	
3	28	2 Tanks	CP - 273 TR	
3	29	3 Tanks	CP - 273 TR	
3	30	8 APC's	CP - 273 TR	
3	31	3 APC's	CP - 273 TR	650
3	32	2 APC's	CP - 273 TR	635
3	33	4 APC's	CP - 273 TR	
3	34	7 Trucks	CP - 273 TR	600
3	35-38	10 Trucks	CP - 273 TR	613, 657
3	39	2 Trucks	CP - 273 TR	
3	40-42	12 Trucks	CP - 273 TR	612, 640
3	43	17 Trucks	CP - 273 TR	
3	44	13 Trucks	CP - 273 TR	
3	45	10 Trucks	CP - 273 TR	
5	1-3	61 Trucks, 1 APC	102 TD - Artillery Regiment	
5	4-8	8 Trucks	102 TD - SA-6	
5	9-13	4 TEL	102 TD - SA-6	645, 652
5	14-16	11 Trucks, 2 APC's	102 TD - FROG Battalion	
5	17-19	61 Trucks, 1 APC	206 TD - Artillery Regiment	623
5	20-21	20 Trucks from 11 MRR Supply	206 TD - Motor Transport Bn	
5	22	25 Trucks from 11 MRR Supply	206 TD - Motor Transport Bn	
5	23	20 Trucks to 11 MRR Supply	206 TD - Motor Transport Bn	
5	24-25	20 Trucks from 66 TR Supply	102 TD - Motor Transport Bn	
5	26	25 Trucks from 66 TR Supply	102 TD - Motor Transport Bn	
5	27-28	20 Trucks to 66 TR Supply	102 TD - Motor Transport Bn	608, 621, 642
5	29	25 Trucks to 66 TR Supply	102 TD - Motor Transport Bn	

TIME - 0700-0800

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME	DETECTION TIME
1	1-4	10 Tanks	Two Lead Battalions - 64 TR	
1	5-7	3 Tanks	Two Lead Battalions - 64 TR	711, 757
1	8	6 APC's	Two Lead Battalions - 64 TR	
1	9	4 APC's, 1 Tank	Two Lead Battalions - 64 TR	
1	10-11	9 Tanks	Two Lead Battalions - 64 TR	715
1	12-13	1 APC, 1 Tank	Two Lead Battalions - 64 TR	
1	14-16	11 Tanks, 1 APC	2nd Echelon - 64 TR	719
1	17	10 APC's	2nd Echelon - 64 TR	
1	18-20	7 Trucks	2nd Echelon - 64 TR	
1	21	2 Tanks	CP - 64 TR	
1	22	3 Tanks	CP - 64 TR	
1	23	8 APC's	CP - 64 TR	
1	24	3 APC's	CP - 64 TR	
1	25	2 APC's	CP - 64 TR	
1	26	4 APC's	CP - 64 TR	722
1	27	7 Trucks	CP - 64 TR	
1	28-31	10 Trucks	CP - 64 TR	732
1	32	2 Trucks	CP - 64 TR	
1	33-25	12 Trucks	CP - 64 TR	709
1	36	17 Trucks	CP - 64 TR	
1	37	13 Trucks	CP - 64 TR	
1	38	10 Trucks	CP - 64 TR	
1	39-42	10 Tanks	Two Lead Battalions - 65 TR	
1	43-45	3 Tanks	Two Lead Battalions - 65 TR	706, 739
1	46	6 APC's	Two Lead Battalions - 65 TR	
1	47	4 APC, 1 Tank	Two Lead Battalions - 65 TR	
1	48-49	9 Tanks	Two Lead Battalions - 65 TR	755
1	50-51	1 APC, 1 Tank	Two Lead Battalions - 65 TR	
1	52-54	11 Tanks, 1 APC	2nd Echelon - 65 TR	729
1	55	10 APC's	2nd Echelon - 65 TR	
1	56-58	7 Trucks	2nd Echelon - 65 TR	
1	59-62	3 Tanks	Two Lead Battalions - 204 MRR	702, 758
1	63-66	7 APC's	Two Lead Battalions - 204 MRR	733
1	67-68	3 Tanks	Two Lead Battalions - 204 MRR	
1	69-70	7 APC's	Two Lead Battalions - 204 MRR	
1	71-72	3 Self-Propelled Artillery	Two Lead Battalions - 204 MRR	
1	73-75	10 APC's	2nd Echelon - 204 MRR	
1	76-78	3 Tanks	2nd Echelon - 204 MRR	
1	79-84	11 Trucks	2nd Echelon - 204 MRR	745
1	85-88	10 Tanks	Two Lead Battalions - 33F TR	701, 732
1	89-91	3 Tanks	Two Lead Battalions - 33F TR	
1	92	6 APC's	Two Lead Battalions - 33F TR	
1	93	4 APC's, 1 Tank	Two Lead Battalions - 33F TR	
1	94-95	9 Tanks	Two Lead Battalions - 33F TR	706, 711
1	96-97	1 APC, 1 Tank	Two Lead Battalions - 33F TR	745

TIME - 0700-0800

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME	DETECTION TIME
2	1-4	10 Tanks	Two Lead Battalions - 212 TR	
2	5-7	3 Tanks	Two Lead Battalions - 212 TR	733
2	8	6 APC's	Two Lead Battalions - 212 TR	
2	9	4 APC's, 1 Tank	Two Lead Battalions - 212 TR	
2	10-11	9 Tanks	Two Lead Battalions - 212 TR	
2	12-13	1 APC, 1 Tank	Two Lead Battalions - 212 TR	727
2	14-16	11 Tanks, 1 APC	2nd Echelon - 212 TR	
2	17	10 APC's	2nd Echelon - 212 TR	
2	18-20	7 Trucks	2nd Echelon - 212 TR	
2	21-24	3 Tanks	Two Lead Battalions - 440 ISR	
2	25-28	7 APC's	Two Lead Battalions - 440 ISR	725, 728
2	29-30	3 Tanks	Two Lead Battalions - 440 ISR	
2	31-32	7 APC's	Two Lead Battalions - 440 ISR	748
2	33-34	3 Self-Propelled Artillery	Two Lead Battalions - 440 ISR	
2	35-37	10 APC's	2nd Echelon - 440 ISR	709, 739
2	38-40	3 Tanks	2nd Echelon - 440 ISR	737
2	41-46	11 Trucks	2nd Echelon - 440 ISR	749
5	1-3	11 Trucks	102 TD	733
5	4-10	5 Trucks, 3 APC's, 1 Tank	102 TD	726, 728, 759
5	11-14	14 Trucks, 1 APC	102 TD	720, 744, 754
5	15-24	12 Trucks, 1 APC	102 TD	707, 731, 731
5	25-34	9 Trucks	102 TD	740
5	35-39	11 Trucks	102 TD	
5	40-44	10 Trucks	102 TD	736, 745, 748
5	45	2 Trucks, 5 APC's	102 TD	
5	46	15 Trucks	102 TD	
5	47-49	72 Trucks, 35 APC's, 15 Tanks	102 TD	
5	50-58	53 Trucks, 8 APC's, 32 Tanks	102 TD	
5	59-63	8 Trucks	102 TD - SA-6	
5	64-66	4 TEL	102 TD - SA-6	
	69	20 Trucks from 11 ISR Supply	206 TD - Motor Transport Bn	
5	70-71	20 Trucks from 66 TR Supply	102 TD - Motor Transport Bn	
5	72	25 Trucks from 66 TR Supply	102 TD - Motor Transport Bn	

TIME - 0800-0900

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME	DETECTION TIME
1	1-4	10 Tanks	Two Lead Battalions - 64 TR	858
1	5-7	3 Tanks	Two Lead Battalions - 64 TR	859
1	8	6 APC's	Two Lead Battalions - 64 TR	
1	9	4 APC's, 1 Tank	Two Lead Battalions - 64 TR	
1	10-11	9 Tanks	Two Lead Battalions - 64 TR	
1	12-13	1 APC, 1 Tank	Two Lead Battalions - 64 TR	
1	14-16	11 Tanks, 1 APC	2nd Echelon - 64 TR	847, 854
1	17	10 APC's	2nd Echelon - 64 TR	
1	18-20	7 Trucks	2nd Echelon - 64 TR	
1	21	2 Tanks	CP - 64 TR	
1	22	3 Tanks	CP - 64 TR	
1	23	8 APC's	CP - 64 TR	842
1	24	3 APC's	CP - 64 TR	
1	25	2 APC's	CP - 64 TR	
1	26	4 APC's	CP - 64 TR	
1	27	7 Trucks	CP - 64 TR	
1	28-31	10 Trucks	CP - 64 TR	
1	32	2 Trucks	CP - 64 TR	
1	33-35	12 Trucks	CP - 64 TR	815
1	36	17 Trucks	CP - 64 TR	832
1	37	13 Trucks	CP - 64 TR	
1	38	10 Trucks	CP - 64 TR	816
1	39-42	10 Tanks	Two Lead Battalions - 65 TR	
1	43-45	3 Tanks	Two Lead Battalions - 65 TR	858
1	46	6 APC's	Two Lead Battalions - 65 TR	
1	47	4 APC's, 1 Tank	Two Lead Battalions - 65 TR	
1	48-49	9 Tanks	Two Lead Battalions - 65 TR	
1	50-51	1 APC, 1 Tank	Two Lead Battalions - 65 TR	
1	52-54	11 Tanks, 1 APC	2nd Echelon - 65 TR	823
1	55-58	3 Tanks	Two Lead Battalions - 204 TSR	849
1	59-62	7 APC's	Two Lead Battalions - 204 TSR	829
1	63-64	3 Tanks	Two Lead Battalions - 204 TSR	844
1	65-66	7 APC's	Two Lead Battalions - 204 TSR	857
1	67-68	3 Self-Propelled Artillery	Two Lead Battalions - 204 TSR	
1	69-71	10 APC's	2nd Echelon - 204 TSR	
1	72-74	3 Tanks	2nd Echelon - 204 TSR	842, 845
1	75-80	11 Trucks	2nd Echelon - 204 TSR	
1	81-84	3 Tanks	Two Lead Battalions - 33F TR	
1	85-87	10 Tanks	Two Lead Battalions - 33F TR	856, 810
1	88	6 APC's	Two Lead Battalions - 33F TR	
1	89	4 APC's, 1 Tank	Two Lead Battalions - 33F TR	
1	90-91	9 Tanks	Two Lead Battalions - 33F TR	
1	92-93	1 APC, 1 Tank	Two Lead Battalions - 33F TR	

TIME - 0800-0900

SCENARIO	TARGET NUMBER	TARGET TYPE	UNIT NAME	DETECTION TIME
2	1	6 APC's	Two Lead Battalions - 212 TR	
2	2	4 APC's, 1 Tank	Two Lead Battalions - 212 TR	
2	3-4	9 Tanks	Two Lead Battalions - 212 TR	
2	5-6	1 APC, 1 Tank	Two Lead Battalions - 212 TR	
2	7-9	11 Tanks, 1 APC	2nd Echelon - 212 TR	830
2	10	10 APC's	2nd Echelon - 212 TR	823
2	11-12	3 Tanks	Two Lead Battalions - 440 MRR	844
2	13-14	7 APC's	Two Lead Battalions - 440 MRR	
2	15-16	3 Self-Propelled Artillery	Two Lead Battalions - 440 MRR	
2	17	7 APC's	Two Lead Battalions - 440 MRR	
2	18-20	10 APC's	2nd Echelon - 440 MRR	
2	21-23	3 Tanks	2nd Echelon - 440 MRR	
2	24-27	10 Tanks	Two Lead Bn, 2nd Echelon - 213 TR	
2	28-30	3 Tanks	Two Lead Bn, 2nd Echelon - 213 TR	841
2	31	6 APC's	Two Lead Bn, 2nd Echelon - 213 TR	
2	32	4 APC's, 1 Tank	Two Lead Bn, 2nd Echelon - 213 TR	
2	33-34	11 Tanks	Two Lead Bn, 2nd Echelon - 213 TR	812, 855
2	35-36	1 APC, 1 Tank	Two Lead Bn, 2nd Echelon - 213 TR	858
5	1-3	11 Trucks	102 TD	
5	4-10	5 Trucks, 3 APC's, 1 Tank	102 TD	849, 855
5	11-14	14 Trucks, 1 APC	102 TD	
5	15-24	12 Trucks, 1 APC	102 TD	814, 826, 859
5	25-34	9 Trucks	102 TD	830
5	35-39	11 Trucks	102 TD	
5	40-44	10 Trucks	102 TD	
5	45	72 Trucks, 35 APC's, 15 Tanks	102 TD	852
5	46	15 Trucks	102 TD	
5	47-49	72 Trucks, 35 APC's, 15 Tanks	102 TD	
5	50-62	53 Trucks, 8 APC's, 32 Tanks	102 TD	801
5	63-63	11 Trucks	206 TD	858
5	64-68	5 Trucks, 3 APC's, 1 Tank	206 TD	
5	69-72	14 Trucks, 1 APC	206 TD	815
5	73-82	12 Trucks, 1 APC	206 TD	806, 852
5	83-92	9 Trucks	206 TD	
5	93-97	11 Trucks	206 TD	831
5	98-102	10 Trucks	206 TD	821, 838
5	103	2 Trucks, 5 APC's	206 TD	
5	104	15 Trucks	206 TD	
5	105-107	72 Trucks, 35 APC's, 15 Tanks	206 TD	804
5	108-116	53 Trucks, 8 APC's, 32 Tanks	206 TD	811, 827, 843
5	117-121	8 Trucks	206 TD - SA-6 Regiment	834, 843
5	122-126	4 TEL	206 TD - SA-6 Regiment	818, 822, 825, 839